Water saving planning in Menara Cibinong Apartment Tower D (Cendana)

Tiara Anantika[1], Eka Wardhani[2] and Nico Halomoan[3]

[1,2,3] Department of Environmental Engineering, National Institute of Technology, Bandung, Indonesia.

Abstract. To save the use of clean water, Menara Cibinong Apartment plans several water saving programs to operational activities. The planned clean water savings consist of recycling gray water and utilizing rainwater. Plumbing tools used are types that require small amounts of water. The research method is carried out by calculating the existing water needs for apartments which have 5 towers of 20 floors each. The population of this apartment is 868. Water saving efficiency is done by determining the difference in water use with and without recycling grey water and harvesting rainwater. Based on the results of calculation of total water needs 209,830 m^3/day with the generation of wastewater generated total 167.86 m^3/day. The composition of the black water of 41.96 m^3/day and grey water 126 m^3/day. The gray water produced will be recycled using a biological-physic- chemical processing process to produce water of decent quality for flushing and watering plants. Water saving potential of recycling gray water of 126 m^3/day. Utilization of rainwaterutilizing the catchment area of the roof of the building has the potential to capture rainwater as much as 30 m^3.

Keywords: Apartment, Saving, Recycling, Rainwater Harvesting.

1. Introduction

The activity that affects City's economic income led to increase the number of immigrants and increase residential development. In 2021 population of Bogor Regency is 5.4 million people [14]. One of the ways to increase residential development is apartment. The Cibinong Tower Apartment is a residential building located Jalan Raya Bogor KM 43, Cibinong, Bogor Regency with a building area of 57,435 m^2 consists of 5 towers and each tower has 20 floors. Development apartment buildings must pay attention to the quality of buildingfacilities and infrastructure so that it fulfills the need for clean water and a sanitation system that is channeled to all apartment residents with a plumbing system as a support activities of building users [9].

The planning for the construction of the Cibinong Tower Apartment is in the Cibinong City has strategic value because it has access like the Central Shopping, Hospitals and Schools. The planning area is also a highrainfall area of 18.09 mm/day with a flood volume of 147.3 m3/day. As an area of high rainfall, it will cause an increase in runoff when it rains Apartment building planning has a function as a comfortable place to live conducive and practical in terms of maintenance and cleanliness, this condition will need clean water that must meet the needs of users where the source apartment clean water is the Regional Drinking Water Company (PDAM), the user PDAM will

continue to increase with population growth in an area, With the increasing demand for PDAM water, it is feared that it will cause a crisis PDAM clean water, therefore efforts are made to utilize rainwater to obtain clean water reuse and save water from primary sources. Use of this water is one of the green building concepts. This green building concept can save water, save energy, and reduce pollutant load, this concept is also supported by Law Number 28 of 2002 concerning Buildings, that every development activity must pay attention to balance with environment and does not have a negative impact on the environment.

2. Materials and Methods

A methodology is to consolidate the current foci of through a review of several projects and institutional guidelines that are geared towards achieving sustainability in the built environment, to make a contemporary checklist of desirable design strategies and building practices for a green building, and to rank the importance of these strategies [13]. The research methods range from theoretical discussions of the usefulness of environmental management tools and questionnaire study on environmental management in the construction industry, to text analytical studies of media's representation of green building and field studies on environmental management in construction projects [5].

The method that will be carried out first is by conducting a literature study to make it easier for researchers to plan, several books used are Procedure for planning of plumbing system, plumbing system, plumbing system in buildings, and plumbing system design and maintenance [9, 11, 12]. Then, primary data collection will be carried out such as Sketch or map the Menara Cibinong Apartment, Clean water sources, Building function, Rainfall data. Furthermore, data processing is carried out to fulfill the planning, the data that must be processed is divided into 3 parts, first for clean water, for clean water it is necessary to do Calculation of the total population of each floor, Calculation of clean water needs, Determination of the capacity of the ground water tank and roof tank 1 clean water, Calculation of pump power and clean water pressure loss, Path planning and dimensions of clean water pipes, Make detailed and isometric plans for clean pipes. Second, namely dirty water, the dirty water needs to be done 1. Calculation of wastewater discharge, Line planning and dimension of wastewater pipes, make detailed and isometric plans for wastewater pipes, Path planning and vent pipe dimensions, Make detailed and isometric plan of the vent pipe, Determination of STP gray water treatment. Third, for rainwater, it is necessary to determine the rainwater catchment area, Determination of the dimensions of the rainwater standpipe gutters, Make a detailed plan of the rain gutter pipe, Calculation of water savings against water conservation. After that, analysis and discussion of the results of data processing was carried out.

2.1. Area Description

The location of this planning was carried out in the Menara Cibinong Tower D (Cendana) Apartment Building Street Raya Bogor KM 43, Bogor Regency. This apartment is a commercial apartment in Bogor Regency and high rainfall, so the concept of rainwater utilization is applied. Building area in Cendana tower (D) this is 731.07 m^2 and building height of 65 meters each, with of floors 20. On the first floor there are 1 lobby room and 14 shops as public facilities, on the 2nd floor there are 17 apartments rooms, 3 floors up to 19th floor there are 192 rooms for C22 types, 48 rooms for C33 types, 34 rooms for C44 types, 2 rooms for C55, 4 rooms for C66, 2 units for C77 and 6 units for C88 for 6 rooms, so that the total number of room units is 288, and on the 20th floor there are halls and prayer rooms.

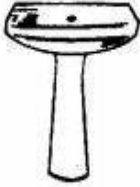**Figure 1.** Menara Cibinong Apartment

Figure 2. Cendana Tower Layout

2.2. Materials

Planning of plumbing installation system needs to know the types of plumbing tools commonly used, 5 types of plumbing such as kitchen sink, lavatory, water closet, urinoir, and shower. These types can be seen in table 1.

Table 1. Types of Plumbing

Types of Plumbing	Image	Types of Plumbing	Image
Kitchen Sink		Urinoir	

Types of Plumbing	Image	Types of Plumbing	Image
Lavatory		Shower	
WaterCloset		-	-

3. Result and Discussion

Plumbing installation system planning in Cibinong tower apartment has 5 towers with 20 towers each. This building has a function as a residential rental and full ownership. Building area of 57,435 m^2. On the 1st floor is intended as a general activity such as the lobby and shops, the second floor is intended as a shop, the 3rd floor is intended as a room for occupancy up to the 19th floor but only different room types, and on the 20th, floor is intended as a general activity such as the hall and the mosque.

Water demand in buildings can be determined based on the number of occupants and plumbing units in the building. Apartment building requires 250 liters/person/day. While the need for garden flush uses the assumption of 5 liters/m^2 for grass or ground cover. Daily water needs in the building can be seen in table 2.

Table 2. Water Needs in Apartment

Floor	Room Function	Amount of Room	Total Population	Standard of Water Requirement (Liter/person/day)	Total Need of Clean Water (L/day)
	Room Type T22	24	2	100	4.800
	Room Type T33	9	3	100	2.700
2	Room Type T44	3	3	100	900
	Room Type T45	2	2	100	400
	Panel Room	1	1	50	50
	2nd Floor Clean Water Needs				8.850
	Total Floor Water Needs				**210.000**

3.1. Green Building

The "green building practice" is defined as a process to create buildings and infrastructure in such a way that minimize the use of resources, reduce harmful effects on the ecology, and create better environments for occupants [3]. Green buildings exhibit a high level of environmental, economic, and engineering performance. These include energy efficiency and conservation, improved indoor air quality, resource and material efficiency, and occupant's health.

The changing environmental effects have an impact on building behavior and performance. Typical areas affected are energy use and emissions, inefficiency and malfunction caused by systems confronted with a shift in operation conditions, and problems caused by overloading. Furthermore, the environmental effects might cause issues, like failures in the electrical grid, which can cause problems for buildings that in themselves are functioning properly [4]. The impact of climate change on buildings is deeply intertwined with consequences for the building occupants and key processes that take place in those buildings. As buildings have different functions, climate change impact assessment studies must be tailored towards the specific needs and requirements at hand. Complex interactions exist for instance between the comfort as experienced by occupants, control settings in the building, and energy consumption of heating and cooling systems [8].

There are 3 uses of the green building concept, water-saving plumbing equipment (WAC 2) The water feature aims to encourage water saving efforts by high efficiency water feature installation. Water recycling is providing water from recycled sources that are sourced from building gray water wastewater to reduce water requirements from sources main., water recycling (WAC 3) The use of rainwater or rainwater runoff can reduce the water requirement of main source. Rainwater utilization (WAC 5) Provision of rainwater storage tanks with a capacity of 80% of the amount of rainwater that falls on the roof of the building is calculated using the value of the average daily rainfall intensity is 10 years. The use of rainwater is necessary processed for reuse.

3.2. Water Saving Efficiency
With the use of the green building concept, the use of water from the main source will be reduced, thus saving water. after the calculation, the water saving efficiency in WAC 2 is 49% or 30,857 liters/day can be seen in table 3. Water saving efficiency in WAC 3 is 19% or 93.33 liters/day can be seen in table 4 and WAC 5 water saving efficiency is 3% or 30 m^3 can be seen in the calculation of 1.

Table 3. Water Saving Efficiency WAC 2

No	Plumbing	Conventional	Water Saving	Unit
1	WC Men	781,2	390,6	Liter/Day
2	WC Women	5.989,2	2.994,6	Liter/Day
3	Urinal	1.302	390,6	Liter/Day
4	Lavatory	911,4	651	Liter/Day
5	Faucet	911,4	651	Liter/Day
6	WC Men	781,2	390,6	Liter/Day
7	Shower	52.080	26.040	Liter/Day
	Total	61.975,2	31.117,8	Liter/Day

Table 4. Water Saving Efficiency WAC 3

	Building Flushing Needs			
Population	Total of Population (person)	Flushing Needs (m^3/day)	Processing Result (m^3/day)	Residual Water Treatment (m^3/day)
Building	868	22,25	115,83	93,33

$$Q = 0{,}278 \, C \, I \, A \qquad\qquad (1)$$

Where:

Q $\quad$ = Volume of captured rainwater (m³/second)
C $\quad$ = Constant (0,9)
I $\quad$ = Rainfall Intensity (mm/hour)
A $\quad$ = Area (m²)

The formula is also used to calculate run offs on buildings. Calculation of rainwater volume with rainfall density (I) of 0,202 m/hour, area (A) of 576 m² and constant (C) of 0,9 had a result of 30 m³ in volume (Q). Water recovery is carried out in the form of rainwater usage in an apartment building, then flowed into a rainwater reservoir and processed into clean water in accordance with applicable quality standards. Following are the results of the calculation of water savings by utilizing rainwater by 70%.

4. Conclusions

Using of green buildings for the apartment buildings is very important for water saving, it can be done with rainwater harvesting or utilization of rainwater as a flushing or watering plants. Total water needs of the apartment is 182.031 m³/days after doing the conservation water saving of 175.695 m³/days.

5. Recommendation

Recommendation of utilization rainwater that needs to be done water quality testing with reference to applicable standards. There is further research on efficiency and requires a large enough area for the treatment of rainwater. So, it requires other alternatives that are more efficient in terms of cost, processing and land area needed is not large.

6. References

[1] Asdak C 2017 Hydrology and Management of Watershed (Gadjah Mada University Press. Yogyakarta)

[2] Castro-Lacouture D et al 2009 Optimization model for the selection of materials using a LEED-based green building rating system in Colombia *Building and Environment* **44** p 1162–1170

[3] Chatterjee A 2009 Sustainable construction and green buildings on the foundation of building ecology *Indian Concrete Journal* **83** p 27-30

[4] Editorial. 2012. The implications of a changing climate for buildings. *Building and Environment* **55** p 1–7

[5] Gluch P 2006 Building green perspectives on environmental management in construction. PhD Dissertation, Chalmers University of Technology, Gothenburg, Sweden.

[6] Green Building Council Indonesia 2013 Green ship for new buildings ver. 1.2 (Jakarta)

[7] Heryani N 2009 Rain harvesting technique: an alternative to meet domestic water needs (Research center for agroclimatic and hydrology department of agriculture: Jakarta)

[8] Nicol JF and Humphreys 2002 Adaptive thermal comfort and sustainable thermal standards for buildings *Energy and Buildings* **34** p 563–72

[9] Noerbambang, Soufyan M and Morimora T 2005 Plumbing system planning and maintenance

[10] Sharpe, William E, and Swistock B 2008 Household water conservation college of agricultural sciences, agricultural research, and cooperative extension college of agricultural sciences (The Pennsylvania State University: Pennsylvania)

[11] National standard of Indonesia 03-6481-2000 about plumbing system

[12] National standard of Indonesia 03-7065-2005 about methods of plumbing system planning

[13] Zachariah JL, Kennedy C and Pressnail K 2002 What makes a building green? *International Journal of Environmental Technology and Management* **2** p 38-53

[14] Central Bureau of Statistics 2019 Bogor Regency Regional Statistics