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Application of Green Building Concept (Rainwater Harvesting) at Menara Cibinong Apartment

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Abstract - The implementation of Green Building criteria is relatively new in plumbing installation. Bogor regency is a city of rain, rainfall data of 18.09 mm/day so that the concept of green buildings can be applied with the use of rain water. Consequently, the integration of these criteria into the design process has the potential to change the design process itself. The implementation of the green building criteria into the conventional design process will be discussed in this paper. The concept of this project is to design an apartment that has 5 towers of 20 floors each with a green building concept. To achieve this goal, the Green Building criteria has been implemented since the beginning of the design process until the detailing process on the end of the project. Several studies were performed throughout the design process, such as Conceptual reviews, where several professionally proved theories related to plumbing installation systems and used for a reference. Rainwater harvesting can save 3,48% of clean water from water sources.

Keywords—Plumbing Installation, Green Building, Rainwater Harvesting

1. Introduction

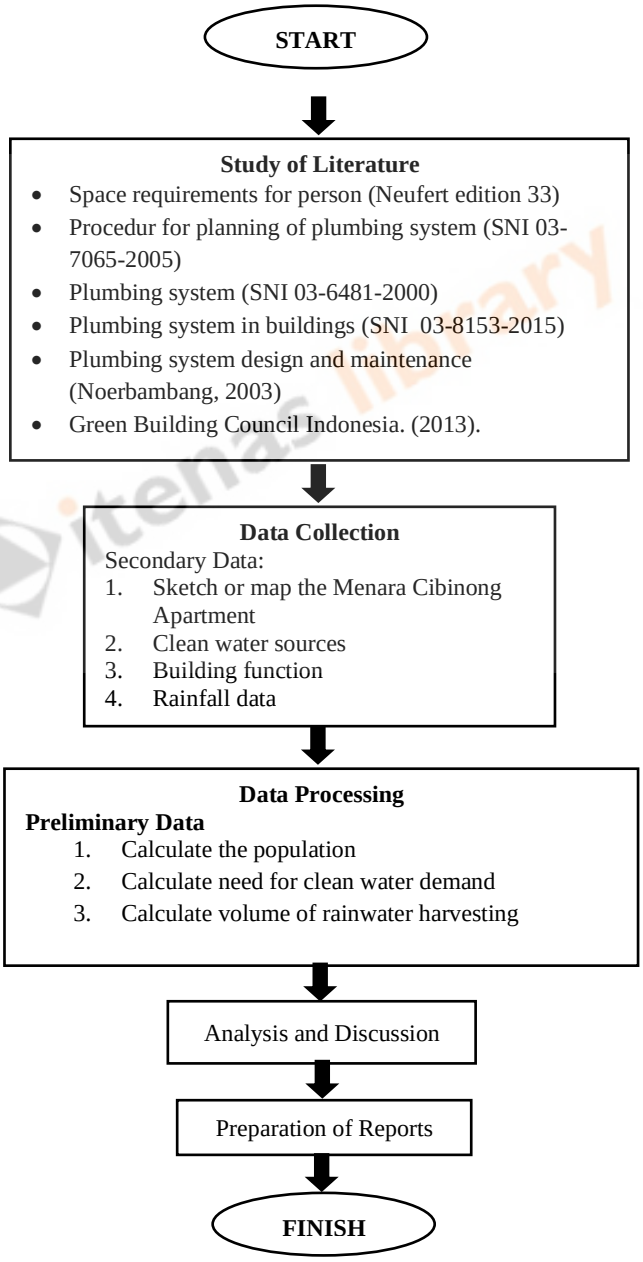
The rapid activity that affects City's economic income is one of them from the tourism sector, tourism raises an increasing number arrivals and increased housing constraction. In 2019 the population of Bogor Regency will be 5.965.410 people (BPS Bogor Regency, 2019). One of the improvements in residential development is the apartment. Menara Cibinong Apartment located on Jalan Raya Bogor KM 43 Cibinong, Bogor Regency with a building area of 57.435 m^2 consisting of 5 towers and each tower has 20 floors. Apartment building construction must pay attention to the quality of facilities and infrastructure of the building so that it meets the needs of clean water and sanitation systems that are channeled to all residents of the apartment with a plumbing system to support the activities of building users (Noerbambang and Morimura, 2005). Planning the construction of Cibinong Tower Apartment is located in the developing area of the City of Cibinong with a high strategic value because it has access to shopping centers, hospitals and schools. The planning area is also a high rainfall area of 18,09 mm/day with a flood volume of 147.3 m^3/day. As a high rainfall area will cause an increase in water runoff when it rains. Planning of Apartment building has the function as a conducive and practical residence in terms of maintenance and cleanliness, this condition will require clean water that must meet the needs of users where the source of clean water is the Regional Drinking Water Company (PDAM), PDAM users will continue to increase with growth residents in an area, with increasing PDAM water demand it is feared will cause a clean water crisis PDAM, Harvesting rain water is an alternative source of water that has been practiced in various countries that often experience water shortages, utilization of rain water is one of the Green Building concepts. The concept of green building can save water, save energy and reduce the burden of pollutants, this concept is also supported by the Law No. 28 of 2002 on buildings, that every development activity must pay attention to balance with the surrounding environment and not cause negative impacts on the environment.

Efforts to harvest rain have become an important part of the global environmental water resources management agenda in the context of tackling water imbalances in the rainy and dry seasons (lack of water), lack of clean water supply for the world's population, as well as flood and drought relief. Rainwater harvesting technique or also known as rain water harvesting is defined as

a way to collect or collect rainwater or surface runoff during high rainfall for later use when rainwater is low. Judging from the scope of its implementation, this technique can be classified into 2 (two) categories: rainwater harvesting techniques with the roof of the building (roof top rain water harvesting), and rainwater harvesting techniques (and surface runoff) with reservoir buildings (Heryani, 2009)

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 (Zachariah et al., 2002). 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 (Gluch, 2006).



a. 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 an 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

b. Survey Design

The implementation of this plan conducts a literature study on theories related to plumbing installation systems, standards and regulations used in relation to planning and green building concepts. User calculations are performed to determine the number of tools plumbing that will be used and the required water debit per day. Determination of the number of population in a building is determined based on the calculation of the area per room and per floor. Area per person according to use can be seen in the following Table 1:

Table 1. Area/Person According To Use

No	Type of buildings	Meters/person
1	Apartment	3
2	Store	1
3	Office building	10
4	Restaurant	1
5	Club house	1
6	Ware house	30
7	Staff room	10
8	Machine Room	30

The more population in a building, the more plumbing tools are used. Calculation as follows (Noerbambang and Morimura, 2005) The required clean water must be sufficient based on the use of clean water according to the type of building. Total population can be seen in table 2.

Table 2. Total of Population in Apartment

Floor	Information	Number of Unit	Number of Population	Total of Population
1	Store	14	56	77
	Lobby	1	10	
	Panel Room	1	6	
2	Room	17	39	49
	Panel Room	1	10	
3	Room	17	39	42
	Panel Room	1	3	
4	Room	17	39	42
	Panel Room	1	3	
5	Room	17	39	42
	Panel Room	1	3	
6	Room	17	39	42
	Panel Room	1	3	
7	Room	17	39	42
	Panel Room	1	3	
8	Room	17	39	42
	Panel Room	1	3	
9	Room	17	39	42
	Panel Room	1	3	
10	Room	17	39	42
	Panel Room	1	3	
11	Room	17	39	42
	Panel Room	1	3	
12	Room	17	39	42
	Panel Room	1	3	
13	Room	17	39	42

Floor	Information	Number of Unit	Number of Population	Total of Population
	Panel Room	1	3	
14	Room	17	39	42
	Panel Room	1	3	
15	Room	17	39	42
	Panel Room	1	3	
16	Room	17	39	42
	Panel Room	1	3	
17	Room	17	39	42
	Panel Room	1	3	
18	Room	17	39	42
	Panel Room	1	3	
19	Room	7	27	30
	Panel Room	1	3	
20	Room	7	27	30
	Panel Room	1	3	
Top floor	Mosque	1	54	80
	Hall	1	26	
Total of Population				933

Sample calculation is taken on the 1st floor for store calculation as follows:

Effective Area = Area x Standard % Effective (1)
= 23 m^2 x 55%
= 12,65 m^2

Total Population = Effective Area : Standard (2)
= 12,65 m^2 : 3 m^2/person
= 4 person/store

because there are 14 stores, then total of people in the store of 56 people.

The need for clean water is used for bathing activities, and washing. Standards for the use of clean water and the need for clean water in apartments can be seen in Table 3 and Table 4.

Table 3. Average Water Usage

Building User	Water Usage	Unit of Time
Apartment	200-250	Liters/Person/Day
Lobby	20	Liters/Person/Day
Panel Room	5	Liters/Person
Store	5	Liters/Store/Day
Garden	5	Liters/meter^2
Hal	25	Liters/Person/Day
Mosque	10	Liters/Person/Day

Table 4. Total of Water Needs in Apartment

Floor	Information	Number of Population	Standard of Water Usage (L/person/day)	Water Needs (L/day)
1	Store	56	5	280
	Lobby	10	20	200
	Panel Room	6	5	30
2	Room	39	250	9.750
	Panel Room	10	5	50
3	Room	39	250	9.750
	Panel Room	3	5	15
4	Room	39	250	9.750
	Panel Room	3	5	15
5	Room	39	250	9.750
	Panel Room	3	5	15
6	Room	39	250	9.750
	Panel Room	3	5	15
7	Room	39	250	9.750
	Panel Room	3	5	15
8	Room	39	250	9.750
	Panel Room	3	5	15
9	Room	39	250	9.750
	Panel Room	3	5	15
10	Room	39	250	9.750
	Panel Room	3	5	15
11	Room	39	250	9.750
	Panel Room	3	5	15
12	Room	39	250	9.750
	Panel Room	3	5	15
13	Room	39	250	9.750
	Panel Room	3	5	15
14	Room	39	250	9.750
	Panel Room	3	5	15
15	Room	39	250	9.750
	Panel Room	3	5	15
16	Room	39	250	9.750
	Panel Room	3	5	15
17	Room	39	250	9.750
	Panel Room	3	5	15
18	Room	39	250	9.750
	Panel Room	3	5	15

Floor	Information	Number of Population	Standard of Water Usage (L/person/day)	Water Needs (L/day)
19	Room	27	250	6.750
	Panel Room	3	5	15
20	Room	27	250	6.750
	Panel Room	3	5	15
Top floor	Mosque	54	10	540
	Hall	26	25	650
Total of Water Needs				181.270

After knowing the water usage standards, Sample calculation is taken for 59 store with water usage standard 5 liters/store/day calculation as follows.

Water Needs (Liters/day) = Total Population x Water Use Standard (3)
= 56 store x 5 Liter/store/day
= 280 Liters/day

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 Tabel 5.

Table 5. Types of Plumbing

No	Types of Plumbing	Image
1	Kitchen Sink	
2	Lavatory	
3	Water Closet	
4	Urionoir	

No	Types of Plumbing	Image
5	Shower	

The concept of green building which is planned with the use of rain water is flowed into the reservoir with gray water, then it is processed, so that the water can be used again. Water that is harvested can be used to multi purpose as, watering the plants wash, bathroom and even can be used to cook if the water quality standards (Sharpe, William E., & Swistock, Bryan, 2008).

c. Data Collection

Primary and secondary data required in this research. Methods used to collect the data in this research is to know the size of the, performing calculations the size of the population, the number of the need of clean water precipitation data and the number of instrument plumbing.

d. Data Analysis

Analysis and discussion of the plumbing system is planned after data processing, with discussion of water requirements, pipe dimensions, and pressure in accordance with quality standards.

3. Result and Disccusion

3.1 Description of Apartment

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 6.

Table 6. Water Needs in Apartment

Water Needs	Total of population (Person)	Standard Clean water needs (L/Person/Day)	Total of water buildings demands (Liters/day)
Lobby	10	20	200
Apartment	717	250	179.250
Store	56	5	280
Panel Room	70	5	350
Hall	26	25	650
Mosque	54	10	540
Garden	152,25 m^2	5 L/m^2/day	761,25
Total of Water Needs (L/days)			182.031

3.2 Green Building

Chatterjee (2009) defined the “green building practice” 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. 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 (Editorial, 2012). 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 (Nicol and Humphreys, 2002).

3.3 Water Saving Efficiency

The rain harvesting system can be divided into two parts, first collecting rainwater on the roof of the building and the second is done by collecting rainwater above ground level. The way to harvest rain from the roof of a building is to drain and collect rainwater from the roof of houses, large buildings and surface water. The amount of rainwater that can be collected is determined by the topography of the flat or inclined catchment area and by the ability of the topsoil to hold water (Asdak, 2007).

The rain water catcher and in the rainwater harvesting system is a surface directly eceives raindrops and drains the rainwater into the system.Water captured by the surface of the catcher is totally unfit to drink. To reach this stage various stages of filtration and filtration are required.

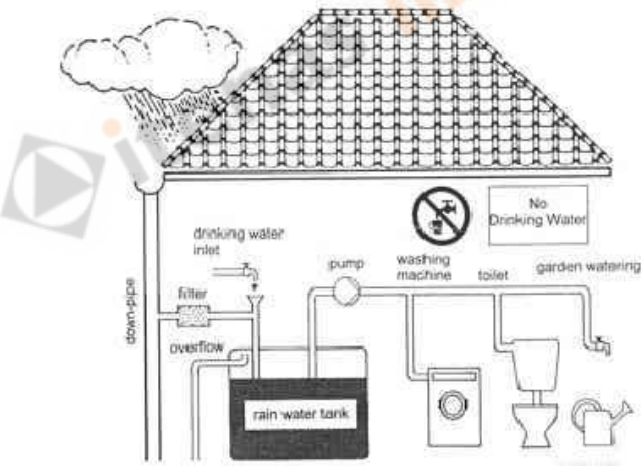


Figure 3. Sketch of Rainwater Harvesting

Utilization of rainwater is used as a water source for flush plants or for flushing activities. Provision of rainwater can be estimated from the area . The formula for calculating the volume of rainwater collected on the roof area of a building is as follows (SNI 03-2453-2002):

$$Vab = 0{,}855 \times C \times A \times R \qquad (4)$$

Where:

Vab = Volume of captured rainwater,
C = Constant
A = Area (m^2)
R = Rainfall (mm/hour).

The formula is also used to calculate run offs on buildings. Calculate volume of rainwater as follows:

Vab = 0,855 x C x A x R
= 0,855 x 0,7 x 731.07 m^2 x 0,01809 m/day
= 7,92 m^3/day

= 7.920 Liter/day

Water recovery is carried out in the form of rain water 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 80%.

Table 7. Water Saving Results

Information	Score
Total of Clean water needs (Liters/days)	182.031
Volume of rain water (Liters/days)	6.336
Total of New Water Needs (Liters/days)	175.695

After diung the calulate, utilization of rainwater can save clean water from sources by 3,48%

4. Conclusions

Using of green buildings for the apartmen buildings its very important for water saving,can be done with rain water harvesting or utilization of rain water as a flushing or watering plants. Total water needs of the apartment is 182.031 m^3/days,after doing the conservation water saving of 175.695 m^3/days.

5. Recommendation

Recommendation of utilization rain water 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

Asdak C. 2017. Hidrologi dan Pengelolaan Daerah Aliran Sungai. Gadjah Mada University Press. Yogyakarta.

Badan Pusat Statistik (BPS), 2019. Statistik Daerah Kabupaten Bogor.

Castro-Lacouture, D., J.A. Sefair, L. Florez, and A.L. Medaglia. 2009. Optimization model for the selection of materials using a LEED-based green building rating system in Colombia. Building and Environment, 44(6): 1162–1170.

Chatterjee, A.K. 2009. Sustainable construction and green buildings on the foundation of building ecology. Indian Concrete Journal, 83(5): 27-30.

Editorial. 2012. The implications of a changing climate for buildings. Building and Environment, 55: 1–7.

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

Green Building Council Indonesia. 2013, Greenship Untuk Bangunan Baru Versi 1.2. Jakarta.

Heryani, Nani. 2009. Teknik Panen Hujan: Salah Satu Alternatif Untuk Memenuhi Kebutuhan Air Domestik. Balai Penelitian Agroklimat dan Hidrologi. Departemen Pertanian. Jakarta.

Nicol, J.F., and M.A. Humphreys. 2002. Adaptive thermal comfort and sustainable thermal standards for buildings. Energy and Buildings, 34(6):563–72.

Noerbambang, Soufyan Moh dan Morimora Takeo. 2005. Perencanaan Da Pemeliharaan Sistem Plambing.

Sharpe, William E. and Swistock, Bryan., 2008, Household Water Conservation College ofAgricultural Sciences, Agricultural Research and Cooperative Extension College of Agricultural Sciences, The Pennsylvania State University.

Standart Nasional Indonesia (SNI) 03-6481-2000 Tentang Sistem Plambing.

Standart Nasional Indonesia (SNI) 03-7065-2005 Tentang Tata Cara Perencanaam Sistem Plambing.

Zachariah, J.L., C. Kennedy, and K. Pressnail. 2002. What makes a building green? International Journal of Environmental Technology and Management, 2(1-3): 38-53.