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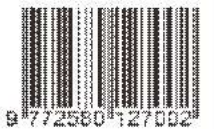
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**GARUDA**  
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# The Use of Plumbing Tools Saving Water With Efforts to Save Clean Water With Application of Green Building Concept at Menara Cibinong Apartment

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**Abstract** – The developing of construction in Bogor Regency affected by citizen's growth caused by urbanization. Citizen's growth of Bogor Regency is estimated to reach 5.9 million people in 2021. Menara Apartment Cibinong construction indirectly could be increasing water needs which affected domestic waste water amount. To minimalizing that problem, there is need to be a planning of plumbing system for clean water and waste water and also the green building concept. With the water conservation includes the reduction of water usage. This water saving plumbing device. The chosen Water Saving Plumbing Equipment because could be saving water up to 33% from initial water needs as amount 305.88 m<sup>3</sup>/day.

Keyword: plumbing, Green Building, water saving plumbing device

## 1. Introduction

The developing of Bogor Regency's construction as the other cities in Indonesia, affected by citizen's growth caused by urbanization. Mainly because of the newcomer which finally stayed. The amount of Bogor Regency's citizen estimated will be reaching 5.9 million people by 2021 with the citizen's growth rate as much as 2.48% in 2019 (RTRW, 2000-2014).

The increasing of hotels and apartments in Bogor Regency gives negative effect, which is increasing domestic waste amount. If those problems are not handled properly, it could be caused environmental and living being pollution. Domestic waste pollution from hotels and apartments activity will be bigger if the domestic waste is dispose directly without treatment first. So there's need to be an enhancement from environmental health aspect to make a safe, comfortable, and healthy environment for the apartment's residents.

Based on Regulation of the Minister of Public Workers and Public Housing of the Republic of Indonesia No. 02 / PRT / M / 2015 About Buildings, the green building is required if a building has a height more than two floors and if the total area of the building is 5.000 m<sup>2</sup> has to filled the mandatory requirement which is water efficiency. The requirements of water efficiency includes water source planning, water saving sanitary implementation, and liquid waste handling. The water source planning includes the main source water of PDAM. Apartment construction concept will be divide into different lanes, which is water distribution lanes, characterized waste water (gray and black water), and the result of water saving.

Purpose of this plan is to plan a water treatment system with a green building concept, so that can be reducing water needs from main source and can be decompose pollution loading. The purpose of this plan is to design a management system for saving water resources and applying water saving equipment.

## 2. Materials and methods

Implementation of Green Building planning in Menara E Matoa apartment building

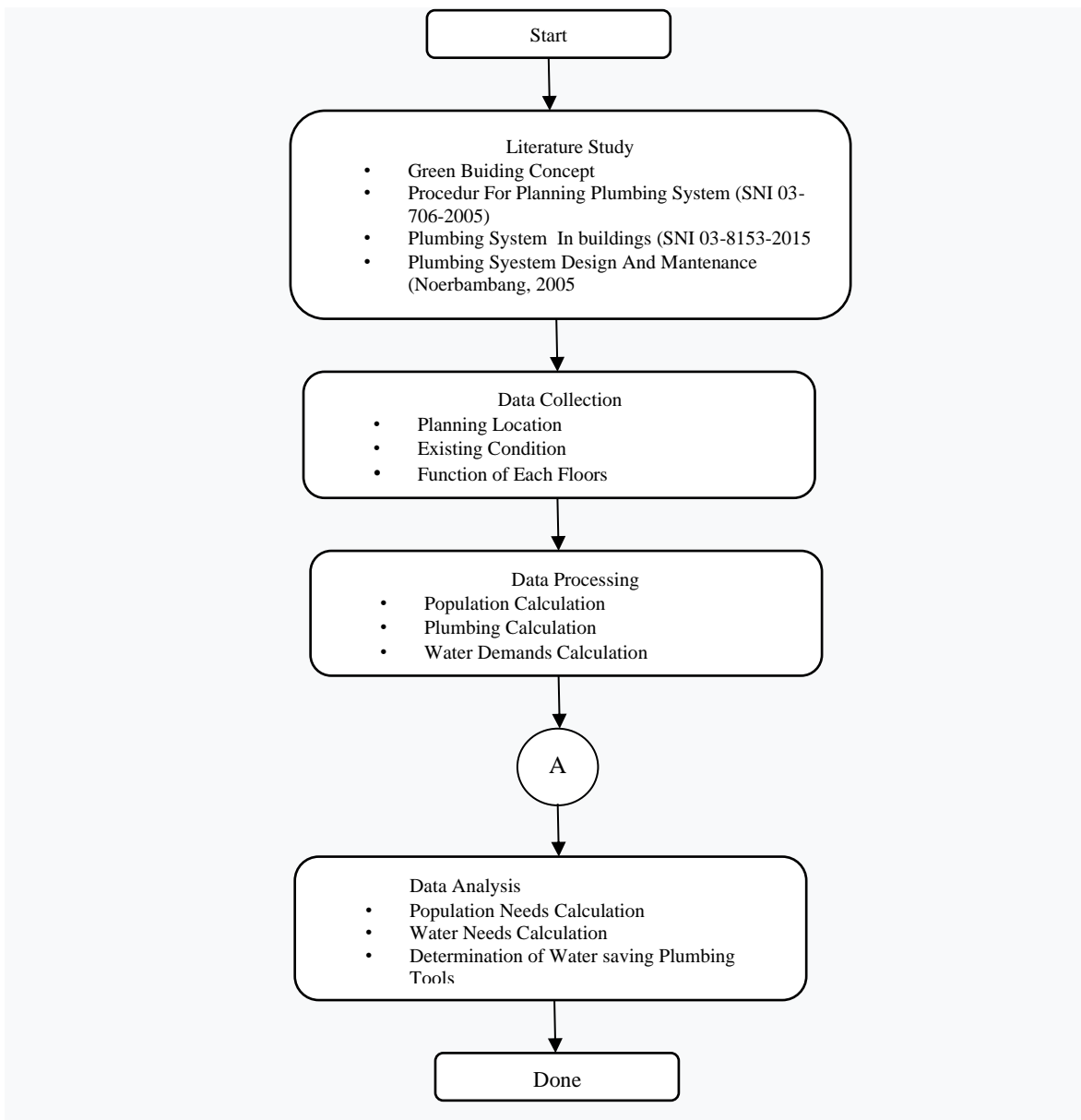


Fig 2.1 Flowchart Planning

Done a literatur study about theories related to plumbing system, standard used in plans, regulations about green building, water usage, water saving plumbing device.

Data collection is including primary data and secondary data. Primary data is a data collected from observation of the planning location. Secondary data is a data collected from earlier reasearcher, includes reasearch journal and reports.

Data process and analysis includes data manipulation into more scientific form. Planning is done with calculating design that has been planned. The planning is includes green building concept. Green building concept implementation to saving a water needs, which is by using Water saving plumbing device.

Water needs calculated based on population amount which can be found in apartment and based on plumbing device that will be used. Knowing the average water usage per person per day, then the water needs for a day will be obtained. The formula to calculate water needs (Noerbambang and Morimura, 2005), is:

$$\text{Water needs (liters/day)} = \text{population amount} \times \text{water usage standard.}$$

Next is the calculation of water demand with the assumption of similarity between field data and the references used

Tabel I Average of Water Usage Per Person Everyday

Building users	Water Use	Unit
Apartment	200-250	Liter/residenti/day
Store	5	Lliter/person/day
Garden	5	Lliter /m2
Mosque	10	Lliter/person/day
Hall	25	Lliter/person/day
Panel Room	5	Lliter/person

The concept of Green Building or the concept to develop buildings that are environmentally friendly and energy efficient, raises the resolution of efficient use of water and energy that can reduce Concept Green Building planned based on:

a. Water Saving Plumbing Device

The implementation of water saving plumbing device and changing the old device so that can reducing the water needs.

- Type Water Saving Plumbing Equipment

b. Water Closet (WC)

The use of water in a plumbing device Water Closet must be able to drain black water waste water. The use of water in toilet pipes with 13-16.5 liters of disposable in the presence of green buildings The use of water closets can be reduced. with or using time <6 / times using flush. Pipe products TOTO provide plumbing equipment type Water Closet with the use of water 4.5 / 3 literswith the use of 4 liters of water for maximum water use and minimum usage of 3 liters, the use of sensors on the plumbing tool Water Closet serves to flush (water flushing) so as to prevent accidental expenditure of water The following is an example of a automatic flush plumbing tool (4.5 liters-3 liters) in **Fig 2.2**



**Fig 2.2** Water Closet Automatic Dual Flush

c. Lavatory

The use of water in a plumbing device lavatory for one-time use 10 liters in the presence of green buildings the use of plumbing device for one time usage must be <8 liters and use of sensors in plumbing devices lavatory can prevent accidental discharge of water The following are examples of plumbing devices lavatory with automatic flush (4.5 liters - 3 liters) in **Figure 2.3**



**Fig 2.3** Lavatory Automatic Flush

d. Urinoir

The use of water in a plumbing device urinoir for one-time use 4.5-5 liters in the presence of green buildings the use of plumbing device for one time usage must be <4 liters and use of sensors in plumbing devices urinoir can prevent accidental discharge of water The following are examples of plumbing devices urinal with automatic flush in **Fig 2.4**



**Fig 2.4** Urinoir Automatic Flush

e. Shower

The use of water in a disposable plumbing device uses 2.4-6.0 liters in the presence of green buildings, the use of a disposable plumbing device must be <4 liters and the use of sensors in the plumbing device can prevent accidental disposal of water The following are examples the shower pipe device automatically in **Fig 2.5**



**Fig 2.5** Shower Automatic

f. Faucet

The use of water in a plumbing device faucet for one-time use 15 liters in the presence of green buildings the use of plumbing device for one time usage must be <8 liters and use of sensors in plumbing devices faucet can prevent accidental discharge of water The following are examples of plumbing devices faucet with automatic flush (4.5 liters-3 liters) in **Fig 2.6**



**Fig 2.6** Fauce Automatic

Tabel 2. Water Needs in Plumbing

Plumbing tool	Water Needs Every Use of Plumbing Tools		
	Water Needs (liter)	occupant (liter)	Visitor (liter)
Closet	6.0	5 flush	2 flush
Shower	12	5 minute	5 minute
Lavatory	7.0	0.15 menit	0.15 menit
Faucet 13mm	15.0		
Faucet 20mm	25.0		
Bathtub	125.0		
Urinoir	5.0	-	2 flush

Tabel 3. Water Consumption Standards

Types Of Plumbing	Usage Factor	Unit
Water Closet	2.3	Person/day
Urinoir	2	Person/day
Lavatory	0.15	Minute/usage
Shower	5	Minute/usage
Tap usage	2.5	Person/day

### 3. Results And Discussion

#### a. Building Description

Menara Apartment Cibinong is a leveled vertical building functioned as rented and full ownership residence. The area of planned apartment construction is 15.000 m<sup>2</sup>. That area is used for apartment, department store, mini water park, food court, and pool. The building is consist of 5 towers (A, B, C, D, and E). The amount of floors in each towers is 20 floors with one floor for office. The height of each tower is 65 meters. The used area divide for closed building area, road and parking lots, park and greens, and also pool.

The planned number of residential units is 1,661 units. Details of the number of rooms for each Tower (3<sup>rd</sup> Floor-20<sup>th</sup> Floor) are as follows: Tower A is 288 rooms, tower B is 236 rooms, tower C is 257 rooms, tower D is 288 rooms and tower E is 438 rooms room unit. The Cibinong apartment flats will also be equipped with commercial support facilities, namely store Details of the number of shophouses for each Tower (1<sup>st</sup>floor-2<sup>th</sup>floor) are as follows: Tower A is 31 units, tower B is 24 units, tower C is 21 units, tower D is 31 units and tower E is 47 units.

The source of water is planned to come from the PDAM water network. To accommodate the water, 1 ground tank and 1 roof tank will be provided in each Menara Cibinong apartment apartment. The dimensions of the clean water tank are designed to be able to supply water needs at peak hours such as morning and evening and to reserve fire fighting water.



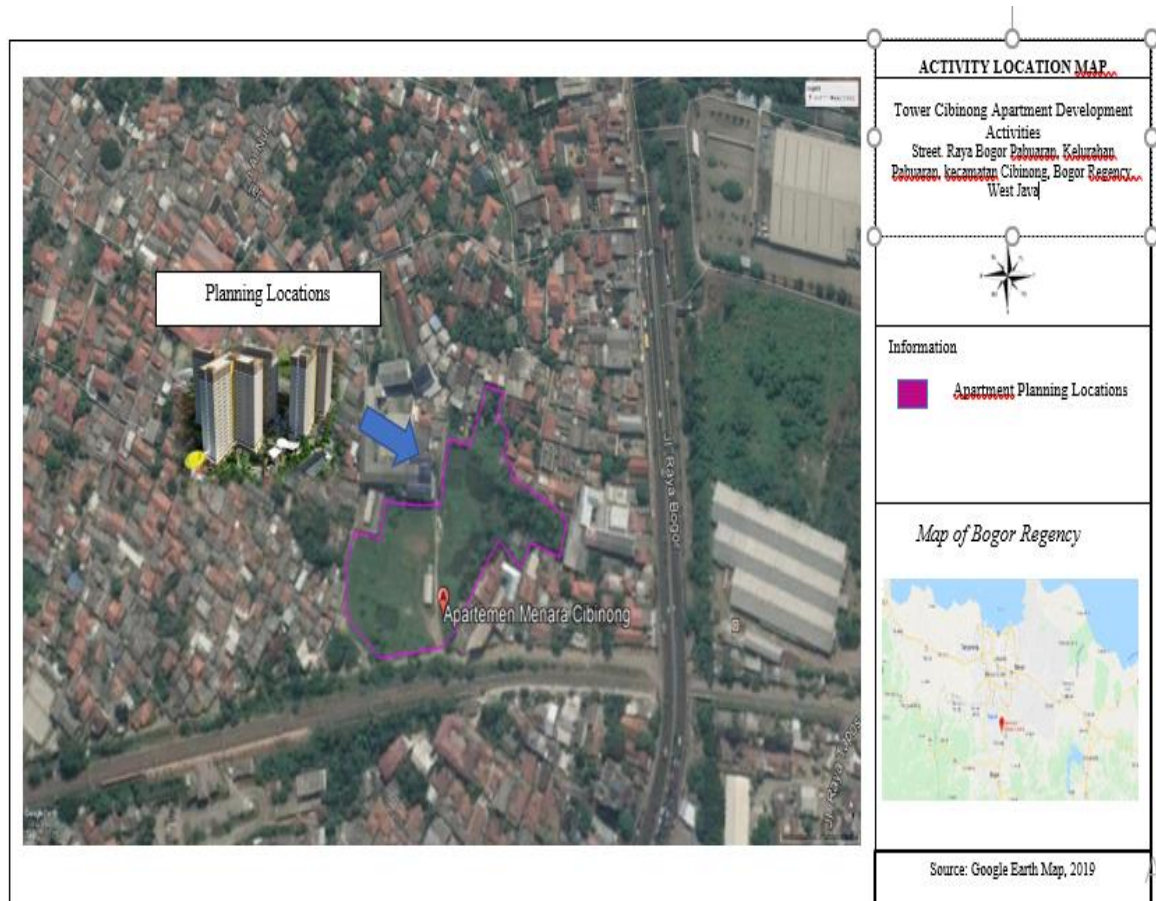


Fig 3.1 Apartment Planning Locations Menara Cibinong

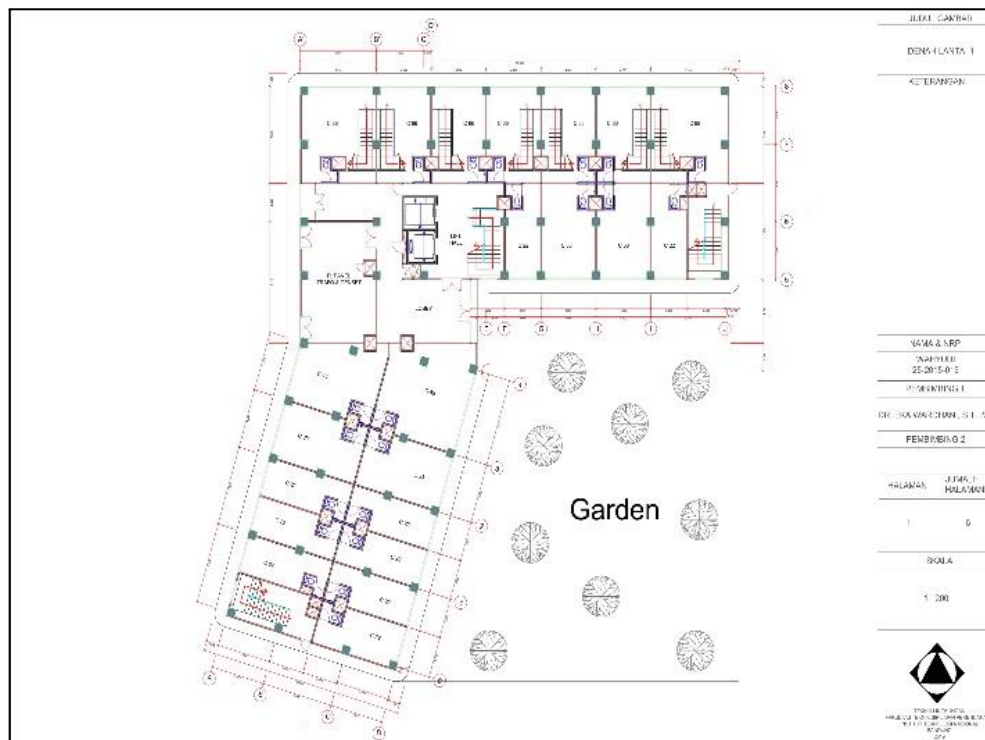


Fig 3.2 Apartment Menara Cibinong Lay Out

b. Calculation of Population, Plumbing needs and Water Needs

Based on the number of people using the estimation method based on the area of each suitable room in the apartment. The area of the room is based on the existing architectural plan. Then by assuming the effective area of each room is 50-60% (Noerbangbang&Morimura), and assuming the floor area used per person for circumvention. For bedroom apartments the assumption is calculated for each room of 2 people.

Determine the need for plumbing tools for each building, it can be estimated by looking at the standard of the plumbing table and the following plumbing table based on the number of male and female comparisons per floor and the table for plumbing requirements for men and women on each floor. The planned planning building is a classification of apartment buildings, according to SNI 8153-2015 concerning Plumbing Systems for Buildings

Clean water needs are determined by the number of participants in the building and the type of designation of the building. In planning the standard clean water supply system that is used in the calculation of the clean water requirements of the SNI 03-7065-2005 building regarding the Plumbing Planning System.

Tabel IV present the total population, Plumbing needs and water needs

Tabel 4. Total Population

Floor	Information	Number of units	Number of Population	Total Population
1	Store	17	89	105
	Lobby	1	10	
	Panel Room	1	6	
2	Store	6	27	60
	Room	15	30	
	Panel Room	1	3	
3 – 11	Room	208	462	520
	Panel Room	8	58	
12 – 18	Room	156	408	426
	Panel Room	6	18	
19 – 20	Room	26	104	108
	Panel Room	2	6	
Top Floor	Mosque	1	71	103
	Hall	1	26	
	Panel Room	1	6	
Total Population				1.322

- Example of calculating number population

$$\begin{aligned} \text{Effective Area} &= \text{Area} \times \text{Standard \% Efective} \\ &= 23 \text{ m}^2 \times 60\% \\ &= 12.65 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{Total Population} &= \text{Effectiv Area} : \text{Standard} \\ &= 12.65 \text{ m}^2 : 3 \text{ m}^2/\text{ person} \\ &= 4 \text{ person} \end{aligned}$$

Tabel 5. Plumbing Needs For Closet

Floor	Total Population	Ratio		Population		Closet	
		male	female	male	female	male	female
1	105	40 %	60 %	42	63	3	4
2 - 20	1.28	40 %	60 %	512	768	317	
Top Floor	103	40 %	60 %	42	63	3	4

Tabel 6. Plumbing Needs For Urinoir

Floo	Total Population	Ratio		Population		Urinoir	
		male	female	male	female	male	female
1	105	40 %	60 %	42	63	3	-
2 - 20	1.280	40 %	60 %	512	768	-	
Top Floor	103	40 %	60 %	42	63	3	-

Tabel 7. Plumbing Needs For Lavatory

Floo	Total Population	Ratio		Population		Lavatory	
		male	female	male	female	male	female
1	105	40 %	60 %	42	63	2	4
2 - 20	1280	40 %	60 %	512	768	317	
Top Floor	103	40 %	60 %	42	63	2	4

Tabel 8. Plumbing Needs Shower

Floo	Total Population	Ratio		Population		Shower	
		male	female	male	female	male	female
2 - 20	1280	40%	60%	512	768	317	

- = Example calculation of Total Plumbing Needs
  - = male population on the 1<sup>st</sup> floor
  - = Total Population x % Ratio
  - = 130 person x 40%
  - = 52 person
  - population of female on the 1<sup>st</sup> floor
  - = Total Population x % Ratio
  - = 130 person x 60%
  - = 78 person

Tabel 9. Water Needs

Floor	Information	population	Standard water requirements L/P	Needs Water L/P	Water Needs m <sup>3</sup> /Day
1	Store	89	5	445	0.675
	Lobby	10	20	200	
	Machine Room	6	5	30	
2	Store	27	5	135	8.175
	Room	30	250	750	
	Machine Room	3	5	15	
3 - 11	Kamar	462	250	116.250	116.54
	Machine Room	58	5	290	
12 - 18	Room	408	250	102.000	102.09
	Machine Room	18	5	90	
19 - 20	Room	104	250	26.000	26.03
	Machine Room	6	5	30	
Top Fool	mosque	71	10	710	1.39
	Hall	26	25	650	
	Panel Room	6	50	30	

Floor	Information	population	Standard water requirements L/P	Needs Water L/P	Water Needs m <sup>3</sup> /Day
Total Water Needs in the Building					254.9
Total Water Needs in the Building x safety Faktor 20%					305.88

- Example of calculating Total water needs
- = Total Population x water needs
  - = 89 orang x 5 liter/ person /day
  - = 445 liters/day
  - = 0.445 m<sup>3</sup>/day

c. Green Building concept

In planning a sustainable construction, there has to be referring to a building which implementing technical, social economy, and environmental aspects. To realizing green building, there must be processes such as: 1. Energi efficiency, 2. Water efficiency, 3. water conservation. The implemented aspect is water conservation to decompose water usage and maximizing waste water treatment and rainwater harvesting to reuse. Green building concept implementation has two alternatives, which is:

i. Use of Water-Saving Plumbing Tools

Green building concept with water saving plumbing device. Is planned can reduce water usage, will affects to water availability without dismissing plumbing device's function.

Tabel 10. Assumption of Water Usage Per/day For Close

Water Closet		
Population	1.486	Person
Average usage	2.3	Per person liter/ flush / day
Flush amount	3.417	Flush/day
Conventional	5	Liters /Flush
Flush Assumption Needs	20.506	Liters /Flush
Flush Assumption Needs	20.50	m <sup>3</sup> /day
Clean Water Consumption	100	%
TOTO	4.5	Liters /Flush
Flush Assumption Needs	15.376	Liters /Flush
Flush Assumption Needs	15.37	m <sup>3</sup> /day
Clean Water Consumption	25	%
Save Water	75	%

Tabel 11. Assumption of Water Usage Per/day For Urinoir

Urinoir		
Population	596	Person
Average usage	2	Per person liter/ flush / day
Flush amount	1.192	Flush/day
Conventional	5	Liters /Flush
Flush Needs	5960	Liters /Flush

Urinoir		
Flush Assumption Needs	5.960	m <sup>3</sup> /day
Clean Water Consumption	100	%
TOTO	3.5	Liters /Flush
Flush Needs	4.172	Liters /Flush
Flush Needs	4.172	m <sup>3</sup> /day
Clean Water Consumption	30	%
save water	70	%

Table 12. Assumption of Water Usage Per/day For Lavatory

Lavatory		
Population	1.486	Person
Duration	0.15	Minute
Tap usage	3.715	day
The use of faucets	557	Minute /day
Conventional	7	Liters/ Minute
water needs	3.899	Liters/day
water needs	3.89	m <sup>3</sup> /day
Clean Water Consumption	100	%
TOTO	4.5	Liters/ Minute
water needs	2.506	Liters/day
water needs	2.5	m <sup>3</sup> /day
Clean Water Consumption	45	%
save water	65	%

Table 13. Assumption of Water Usage Per/day For Shower

Shower		
Population	1280	Person
Duration	5	Minute
Tap usage	2.994	day
The use of faucets	14.970	Minute/day
Conventional	12	Liters/ Minute
water needs	17.9640	Liters/day
water needs	179.64	m <sup>3</sup> /day
Clean Water Consumption	100	%
TOTO	6	Liters/ Minute
water needs	89.820	Liters/day
water needs	89.82	m <sup>3</sup> /day
Clean Water Consumption	50	%
save water	50	%

Tabel 14. Save Water

Types Of Plumbing	Conventional	TOTO	Unit
Water Closet	6.855	4.798	m <sup>3</sup> /day
Urinoir	5.960	4.172	m <sup>3</sup> /day
Lavatory	3.89	2.5	m <sup>3</sup> /day
shower	179.64	89.82	m <sup>3</sup> /day
Total User	196.345	101.287	m <sup>3</sup> /day
save water	0	33	%

By comparing Table XIV, there is a reduction of water needs in common plumbing device. So that the green building concept with water saving plumbing device could reduce water usage as 95.058 m<sup>3</sup>/day, which originated from 196.345 m<sup>3</sup>/day to 101.287 m<sup>3</sup>/day.

#### 4. Conclusions

Water needs in Menara Apartment Cibinong is based on population, which is 305.88 m<sup>3</sup>/day with main source of water is PDAM. The implementation of green building in is the water saving plumbing device, which can reduce water needs about 95.058 m<sup>3</sup>/day, originally from 196.345 m<sup>3</sup>/day to 101.287 m<sup>3</sup>/day. and reducing water needs as much as 33%. So that the water conservation can be implemented.

#### 5. Recommendation

There's need to be a further research about water efficiency includes water usage, sanitary water saving device.

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