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Enviromental housing planning with rainwater harvesting system as clean water resources using 3D in Sumenep regency

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ABSTRACT. Housing is as a place where a house that is built-in groups such as urban settlements equipped with facilities and infrastructure along with public utilities habitable home. Many housing developments in Sumenep, but not in accordance with the existing Indonesian National Standards. The purpose of environmentally sound housing is where the housing is in compliance with the Indonesian national standard stipulations concerning various aspects of housing planning, plus plumbing plans within the residential area, where Plumbing serves to reuse rainwater as clean water. The requirements of data required for basic residential environmental planning research are primary and secondary data. Location planned in Pangarangan Village, Kab. Sumenep. Primary data is the result of data. The data used in this study is the size of the land area. Secondary data is data obtained from the agency concerned. The data used in this study is rainfall data. Based on data analysis techniques used in this study is quantitative data analysis, and the calculations are done by Design House using AutoCAD and 3D Sketchup applications, Plumbing Installation Analysis, and Budget Plan using Exel application. The total land area to be planned for housing is 3,400 m2, the land utilized for the house is 1,800 m2, and the land for public facilities and social facilities is 1,600 m2. From every house that is planned in this housing, every house is given rainwater storage to be reused into clean water. The results of the analysis and calculation of clean water for type 65 as many as 10 units of houses and type 85 of 4 units of houses in 2019 amounted to 6.72 m3 / day. So the need for clean water for every home is sufficient for daily needs.

Keywords: designing, rainfall, plumbing, 3D Sketchup.

1. Introduction

The house is a place for everyone to live which give them a comfort, safe and secure. The need for decent housing for the community is increasing due to population increase every year. Currently in Sumenep Regency has a lot of housing, but not environmentally friendly. Housing continues to be built to meet community demand without thinking about environmental impacts. based on this problem we try to provide solutions to fulfill the needs of housing for people and this also based on healthy environmental requirements.[1,5]

With the environmentally friendly housing planning, it is also planning for plumbing system for the utilization of rainwater into clean water in order to reduce the available clean water. With this plumbing system, users can save water from drilled wells or PDAM (*Perusahaan Daerah Air Minum* -

Regional Water Utility Company) [7]. For designing we use AutoCAD application to draw buildings. And to make it easier for planners to present the results of images in real form, we use 3D images with the SketchUp application. SketchUp application can introduce the area and form of house design with 3D images to the public.

The study case is a housing planning in Pangarangan Village with an environmental perspective. The purpose of environmentally friendly housing is built a hounsins in accordance with the provisions of the Indonesian national standard which involves various aspects in the planning of a housing. The planning is one floor house with 2 types of houses, places of worship (mosque), rainwater reservoirs that function to use rainwater as clean water assistance in a house, the shelter is planned for each house. To draw these plans, the authors use the AutoCAD application so that the results of the planned drawings are clear and detailed. The author also uses a sketch up application to display images in 3D, it serves to make it easier for the image reader, image readers can also see the beauty of the house that will be built. This case study takes place in Rampak Sumenep Village, Kota District, Sumenep Regency. The purpose of this study is to plan an environmentally friendly housing with a plan that is in accordance with the wishes and has good quality. And equipped with plumbing to utilize rain water that will be reused for the benefit of every house in the housing.

2. Methods

2.1. Livable Housing Criteria

Housing is a land that is converted into a group of buildings in the form of livable houses and equipped with adequate facilities and infrastructure [6]. housing itself is divided into two. The first is residential housing, which is housing that has the same shape and size, planners only provide a few home design models, in terms of exterior and interior design planners on average offer simple and minimalist designs. The second is cluster housing, which is housing that has different interior and exterior designs, this housing is also called elite housing because it is equipped with complete facilities and quality. This housing also has one entrance access and is equipped with a guard post, so it is not surprising that this cluster housing has very high security [1].

2.2. Pumbing Installation

Domestic (household) water needs are calculated based on population and per capita water needs. The criteria for determining the domestic water needs issued by the Center for Irrigation of the Ministry of Public Works uses the parameter of population as a determination of the amount of water needed each capita each day. And the standard of domestic water needs for household is 120 liter/person/day [2].

2.3. Rainwater Harvestting

Rainwater Harvesting (RWH) is an old-fashioned method that was popularized again by storing rainwater for later re-use. The consideration for using rainwater is the pH of rainwater which is near neutral and relatively free of pollutants. Rainwater harvesting is the process of utilizing rainwater by being accommodated and can be used for various purposes. Rainwater is usually collected or harvested from rooftops, concrete floors in houses, roads and other waterproof surfaces. Rainwater then flows along the road (gutter) and enters a collection tank. Rain harvesting is very helpful in reducing runoff from rain.Rainwater harvesting is intended to utilize runoff. Runoff can be caught and collected from the roof runoff or the land surface or seasonal rivers. A water harvesting system that harvests runoff from the roof of a building or the land surface is included in the category of rainwater harvesting [7,8].

Calculate rain intensity using a formula

$$I = \frac{R24}{24} \left(\frac{24}{t} \right)^{2/3} \quad (1)$$

I = Rain Intensity (mm/hour)

R_{24} = Maximum Rainfall for 24 hours (mm)
T = The duration of rain (hour)

The mainstay rainfall calculation is done through the processing of the existing annual rainfall discharge data by ranking the annual average discharge data ranking from the highest value to the lowest value based on the average annual rainfall. Then each opportunity is calculated with this formula:

$$P\,(\%) = \frac{m}{n+1}\ x100\% \quad (2)$$

m = sequence number
n = amount of data
P = opportunity

To find out how much the percentage (%) of rainwater that is accommodated to the water needs within a certain time period is used this formula:

$$\text{Rasio Persentase } (\%) = \frac{\sum Q}{B}\ x100 \quad (3)$$

$\sum Q$ = Amount of rainwater discharge in a reservoir (m^3)
C = Total one month water requirement (m^3)

Rainwater basin discharge is the volume of rainwater that is accommodated from several houses in the housing that are chosen as rainwater collectors. The formula for obtaining the inflow is as follows:

$$V = R \times A \times C \quad (4)$$

V = Amount of collected water volume (m^3)
R = Average rainfall that occurs during one day (mm)
A = Area of house roof / catchment area (m^2)
C = Runoff coefficient (f = 0.75 - 0.95)

2.4. 3D SketchUp

Sketchup is an application for 3D images, this application is usually used by architects to present the results of the picture. With this application, we can pour creative ideas in the form of 3D images in the form of rough sketches or realistic final drawings. Google sketchup is a 3D graphic design application that is usually used to create houses and other applications. The benefits of google sketchup are many, including creating several interior and exterior designs. 3D sketchup is indeed very easy for us to learn. We can use Google Sketchup to describe a 3D object that is very detailed and with very satisfying results even the same as the original when it has gone through rendering [3,4].

3. Main Results

3.1. Liveable House Planning

According to SNI 03-1733-2004 every houses for livable living must have good air circulation; adequate lighting; fulfilled clean water for drinking, coking, washing, etc; waste water disposal; residential health and green open space. Based on this, we planned houses with two types, type 65 and type 85. In each type is planned to use maximum ventilation as a medium of air circulation and the entry of sunlight during the day. It also planned an effective plumbing pipe to supply clean water and remove dirty water.

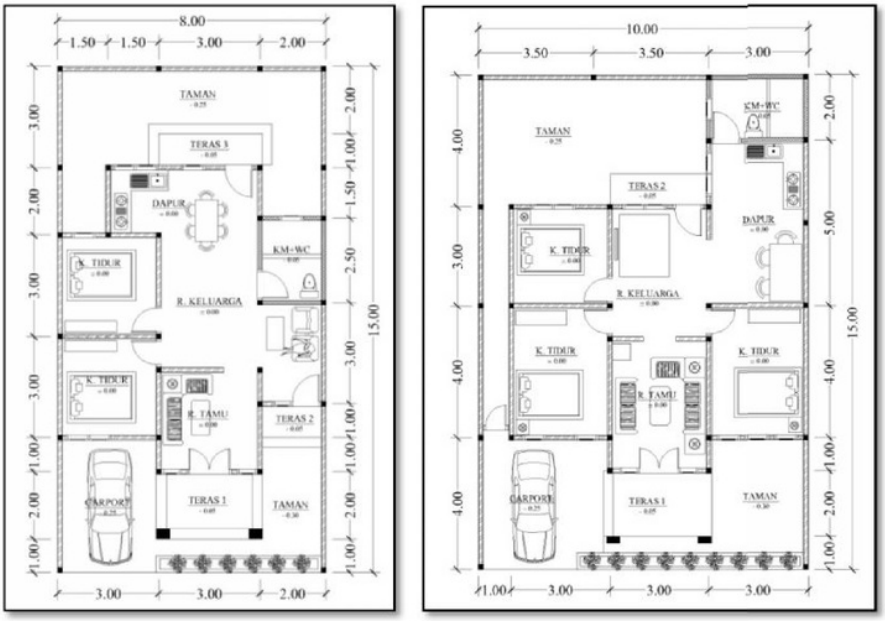

Figure 1. Plan of House type 65 (left) and type 85 (right)

3.2. Plambing System Planning

Calculating the raw water needs of residential houses using SNI (*Standar Nasional Indonesia* – Indonesian National Standard) number 03-7065-2005 for water needs according to building functions. And according this standard, the average water demand for house is 120 litre/person/day. From this value, we can calculate the total raw water requirements according to the population. From two types of house (type 65 and type 85) the total population is 56 people (40 people for houses tye 65 and 16 people for houses type 85). The result of calculation of water requirment can be seen in table 1 below:

Table 1. Calculation of Water Requirements Results

No.	House Type	Population (people)	Average water demand liter/person/day)	Total raw water requirements (liter/day)	Total raw water requirements (m3/day)
1	65	40	120	4800	4,8
2	85	16	120	1920	1,92
Total		**56**	**120**	**6720**	**6,72**

In this study, the rainwater data station that is used has the longest and most complete data is Sumenep Irrigation rain station. Rain data used is from 2008 - 2017 (10 years). Example calculation to get the probability of rainfall mainstay no. 1 (one) as follows:

$$P(\%) = (m / (n + 1)) x100\% = (1 / (10 + 1)) x100\% = 9{,}09\%$$

The calculation of the next mainstay rain probability can be seen in table 2 below,

Table 2. Rainfall Mainstay Probability

Year	Rainfall (mm/Year)	Order		Mainstay (%)	Year
		No.	Rainfall (mm/year)		
2008	1329	1	2847	9,09	2013
2009	804	2	2823	18,18	2014
2010	1769	3	2640,3	27,27	2012
2011	971	4	1769	36,36	2017
2012	1125,4	5	1329	45,45	2016
2013	2640,3	6	1204,9	54,55	2010
2014	1204,9	7	1125,4	63,64	2008
2015	840	8	971	72,73	2011
2016	2823	9	840	81,82	2015
2017	2847	10	804	90,91	2009

Mainstay rainfall can be obtained by taking the average value in a year that has a probability value more than 80%, so the mainstay rainfall value is chosen based on a value close to the average rainfall value. From table 2 the chance of rainfall is chosen 81.82%, and 90.91% is the data for 2009 and 2015.

Table 3. Stipulation of Mainstay Rainfall

Year	Month												
	Jan	Feb	March	Apr	Mei	Jun	Jul	Agust	Sep	Okt	Nov	Des	Total
2009	137	87	51	89	187	27	0	0	0	0	125	101	804
2015	175	301	67	161	59	0	0	0	0	0	0	77	840
Average Rainfall	156	194	59	125	123	13,5	0	0	0	0	62,5	89	822
Maninstay Rainfall	137	87	67	89	187	27	0	0	0	0	125	101	820

From table 3 it shows that rainfall in June, July, August, September and October is very small at <50 mm / month which tends to experience the dry season. Furthermore, from the calculation of the mainstay rainfall is calculated the volume of water supply that can be accommodated for each month. With the roof area data for each area, the result of mapping the area can be calculated the volume of rainwater availability. The rainwater availability volume for November to October are shown in figure 2.

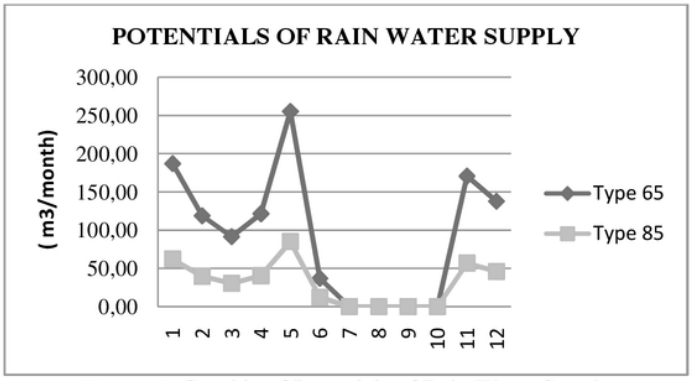

Figure 2. Graphic of Potentials of Rain Water Supply

Based on the calculation of rainwater supply and raw water demand, the volume of rain water supply is sufficient for raw water needs. So that the percentage (%) is calculated to at least meet the overall raw water needs of the average residential occupant. From the results of the study obtained a comparison between raw water needs and rainwater supply is to combine the data as in figure 3.

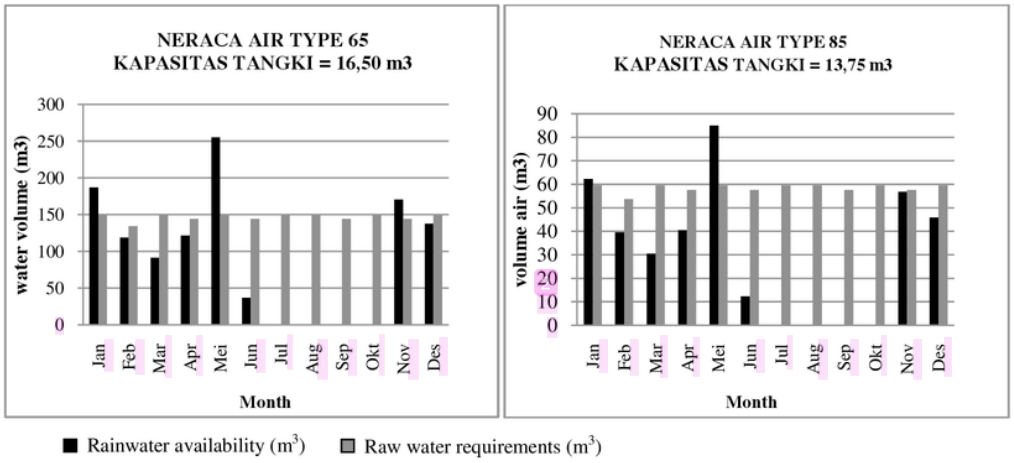

Figure 3. Comparison of Rainwater Availability to Raw Water Needs

Based on the comparison between rainwater supply and raw water requirements, Vsuplay> Vdemand is obtained. This is main, the rainwater supply is sufficient to meet the overall raw water needs of the average householder. So the calculation of tank volume is based on the mainstay supply in January, February, April, May, November, and December which tends to supply high rainwater as shown in figure 1 with quantities of 187, 119, 121, 255, 255 and 138 m^3/ month for type 65 and 62,40,40,85,57 and 46 m^3/month for type 86.

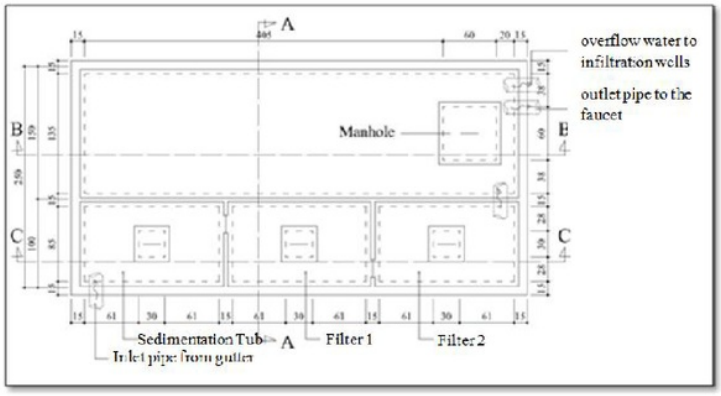

Figure 4. Top view of Rainwater Shelter 1.50m x 5m for house Type 65

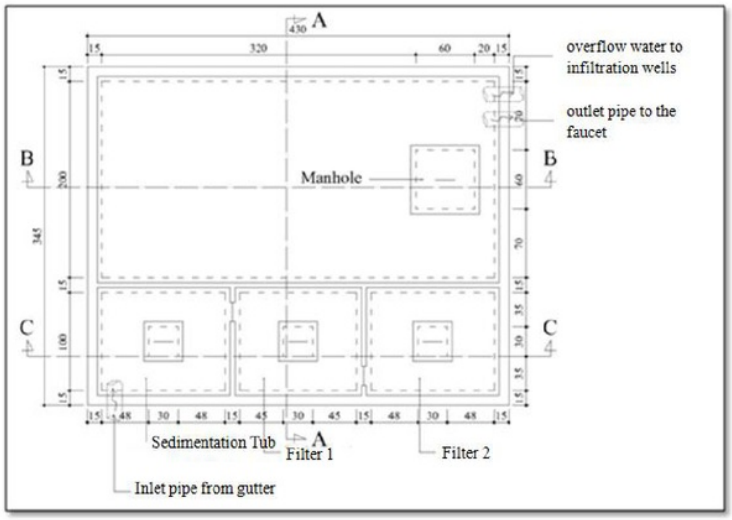

Figure 5. Top view of Rainwater Shelter 1.50m x 5m for house Type 85

The drainage system in Rainwater Harvesting is using a pump system. In this system the water that is collected in the rainwater reservoirs will be distributed by Pumping System through distribution pipes to the house channel. Where the rain water that is received by the roof of the house is flowed through the gutter to the rainwater reservoir, after the shelter is filled then the homeowner can use it again for clean water unless it is not used for drinking water.

3.3. 3D Design by Sketchup

3d design is used to facilitate prospective housing buyers in describing the house they will occupy later. 2-dimensional depiction of the design is done using the help of autocad software which is then visualized into 3d using the help of a sketchup program. 3D images consist of layouts, type 65 and type 85 houses, places of worship (mosques) and green open spaces.

House Type 65

House Type 85

Green Open Space

Layout

Figure 6. 3D Design by SketchUp

4. Conclusions

Based on the analysis results, planning of livable homes according to SNI 03-1733-2004 every house for livable living must have ventilation in each room, adequate lighting, clean water, Waste water disposal, residential health, and the presence of green open spaces. One of the efforts to preserve the environment, this housing complex uses a rainwater harvesting system as a source of raw water. Based on the comparison between rainwater supply and raw water requirements, Vsuplay> Vdemand is obtained. This is main, the rainwater supply is sufficient to meet the overall raw water needs of the average householder. So the calculation of tank volume is based on the mainstay supply in January, February, April, May, November, and December which tends to supply high rainwater as shown in figure 1 with quantities of 187, 119, 121, 255, 255 and 138 m^3/ month for type 65 and 62,40,40,85,57 and 46 m^3/month for type 86. Water distribution system planning that is accommodated in the rain water reservoirs is distributed in a Pumping System through a pumping machine which then distributes the system to the existing housing in the service area, in this case housing in Pangarangan village.

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References

[1] Badan Standarisasi Nasional. 2004. *Tata Cara Perencanaan Lingkungan Perumahan di Perkotaan* (SNI 03-1733-2004).

[2] Badan Standarisasi Nasional. 2005. *Tata Cara Perencanaan Sistem Plambing* (SNI 03-7065-2005).
[3] Bhirawa WT, SE, ST, MT, MM. 2012. *Penggunaan Google Sketch Up Software Dalam Merancang Kopling Flans*. Universitas Suryadarma Jakarta : Jakarta.
[4] Chandra Handi. 2012. *80 Trik Tersembunyi Autocad 2012*. Maxikom :Palembang.
[5] Harjanto Totok. 2016. Strategi *Pembangunan Perumahan Di Kawasan Perkotaan*, Jurnal Ekonomi, Vol. 5 No. 2 Juli-Desember 2016 : 47 – 48(online)
[6] Ibrahim Bhachtiar. 2001. *Rencana dan Estimate Real of Cost*. Jakarta : PT. Bumi Aksara.
[7] Indah Amelia Beza, Yohanna Lilis H, Imam Suprayogi, "Kajian Pemanfaatan Air Hujan Sebagai Pemenuhan Kebutuhan Air Bersih Di Pulau Kecil (Studi Kasus : Desa Concong Tengah Kecamatan Concong)", Fteknik Volume 3 no. 1 Februari 2016 (online). (http://media.neliti.com/media/publications/189352-ID-kajian-pemanfaatan-air-hujan-sebagai-pem.pdf accessed 10th February 2019)
[8] P. Nugro Rahardjo, "Teknologi Pemenuhan Kebutuhan Air Bersih Masyarakat Kepulauan Seribu Melalui Optimasi Pemanfaatan Penampungan Air Hujan," Lingkungan, Vol. 1 No. 3, Desember 2000: 195 – 205 (online). (http://ejurnal.bppt.go.id/index.php/JTL/article/download/181/82 accessed 12th February 2019)

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