



JURNAL PENDIDIKAN GEOGRAFI

THE FEASIBILITY STUDY OF ENVIRONMENTALLY FRIENDLY URBAN DRAINAGE SYSTEM MANUFACTURE AND ITS RELEVANCE TO ECOLOGICAL INTELLIGENCE IN FLOOD PRONE AREA IN MANGKUBUMI DISTRICT OF TASIKMALAYA

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ABSTRACT

The aims of this research are to (1) analyze the type of infiltration well that can be applied in Mangkubumi District of Tasikmalaya, and (2) analyze the relevance of infiltration well manufacture with the ecological intelligence development. This research is a descriptive quantitative analytics with the research location of Mangkubumi District. The method of collecting data is secondary gained through literature review. Data analysis has been done through descriptive analysis of physical condition. The research result shows that Mangkubumi District generally fulfills the technical terms of infiltration well manufacture based on SNI 03-2453-2002. The type of infiltration well that can be applied in Mangkubumi District is type II, the infiltration well with adobe and red brick without cement plaster with a hole between them and type A retention pool. The infiltration well manufacture can be applied at school project learning method of geography subject therefore the ecological intelligence of students can grow and develop because they experience it directly.

Keywords: drainage, flood, ecological intelligence

ABSTRAK

Tujuan penelitian ini adalah untuk (1) menganalisis tingkat infiltrasi di Kecamatan Mangkubumi Tasikmalaya, (2) mengetahui relevansi infiltrasi pembuatan sumur dengan pengembangan kecerdasan ekologis. Penelitian ini merupakan penelitian deskriptif kuantitatif dengan lokasi penelitian Kecamatan Mangkubumi. Data yang digunakan adalah data sekunder berdasarkan hasil tinjauan pustaka. Analisis data yang digunakan adalah analisis deskriptif. Hasil penelitian menunjukkan bahwa Kabupaten Mangkubumi telah memenuhi persyaratan teknis pembuatan sumur resapan berdasarkan SNI 03-2453-2002. Jenis sumur infiltrasi yang dapat diterapkan di Kecamatan Mangkubumi adalah tipe II, sumur resapan dengan bata merah tanpa plester semen dan kolam retensi tipe A. Pembuatan sumur infiltrasi dapat diterapkan pada metode pembelajaran proyek sekolah mata pelajaran geografi sehingga kecerdasan ekologi siswa dapat berkembang.

Kata kunci: drainase, banjir, kecerdasan ekologi

INTRODUCTION

The urbanization that happen in Tasikmalaya including in Mangkubumi District not only gives positive impacts but also negative impacts of environment destruction which one of them is a puddle phenomenon and flood as a consequence of the amount of harden land as a

reflection of the changing of land usage. This things get worse by the low level of community awareness of the environment preservation. One of the examples is a small amount of plant in the neighborhood besides disposing garbage in an unappropriate place. After the rain has stopped, there are many kinds of

garbage on the street that clog the drainage channel. According to the note of disaster management implementing unit of Tasikmalaya, facing the rainy season, six out of ten districts in Tasikmalaya has a high potential of flood. Flood is more likely caused by the broken of drainage channel that clogged by a pile of garbage.

The six districts that prone to flood are Mangkubumi, Indihiang, Tawang, Cihideung, Cipedes dan Purbaratu. Meanwhile Cibeureum, Tamansari, Kawalu, and Bungursari are prone to landslide eventhough in a small scale. It is reasonable that Mangkubumi District is mentioned as the first district with a high potential of flood by Implementing Disaster Management of Tasikmalaya ("Satlak PB") because according to them, Mangkubumi District has most puddle area compare to other districts in Tasikmalaya. Based on the problem of puddle and flood that caused by a bad drainage channel and the low level of community awareness to the environment therefore by manufacturing and normalisation of drainage system should be done by the government. However the problem that related to the budget, they have to find another problem solving alternative that doesn't need a high cost and can be done easily. One of the solution is environmentally friendly urban manufacture drainage system by making an infiltration well.

In order to handle it more comprehensive and to increase community awareness of environment preservation therefore community involvement in the process is a good solution. Based on the problem mentioned, this thesis tries to discuss infiltration well manufacture as a part of environmentally friendly urban drainage system implementation as a flood handling alternative and puddle in Mangkubumi Tasikmalaya and to develop ecological intelligence as well which is an

understanding of hidden ecology impact and a solution to improve it (Gufron, 2014) because Utina (2009) says environment problem, including flood the solution is not only related to technical things but also a detail of human spiritualisation, way of thinking and awareness to the nature and ecology behavior to preserve natural balance, therefore ecological intelligence is needed.

The aims of this research are to (1) analyze the type of infiltration well that can be applied in Mangkubumi District of Tasikmalaya; and (2) analyze the relevance of infiltration water manufacture with the ecological intelligence development.

RESEARCH METHOD

The methodology in this paper is a descriptive analytic quantitative. The research as clear as possible shows a detail of a condition without any treatment to the object of research.

The location of the research is in Mangkubumi District with the object in the areas that prone to flood and puddle when the rainy season comes. The areas are along A.H Nasution street (Mangkubumi) especially Linggajaya (bypass), Mangkubumi, and Cipari. The data collecting method in this research is secondary that gained through literature review from some sources such as book, journal, article and another internet source. Data analysis has been done through descriptive analysis of physical condition (land condition, permeability, ground water level and social (government regulation). The feasibility test is based on general terms and infiltration well manufacture technique SNI (Indonesian National Standard) and relevant previous research result.

FINDINGS AND DISCUSSIONS

The Feasibility of Infiltration Well Manufacture

General Terms

The determination whether one area can build an infiltration well or not is based on the general terms and technical condition that standardized by Indonesian National Standard (SNI) 03-2453-2012 the revision of SNI 03-2453-1991. The general terms of infiltration well manufacture according to SNI are:

1. The infiltration well placed on flat area
2. The absorbed water is unpolluted raindrops
3. The infiltration well should consider the safety of surrounding building.
4. It should consider local regulation.
5. The things that don't follow this regulation should be approved by authorized agency.

According to the description above, "PERDA PJPR"(2008) appendix shows that Tasikmalaya is one of medium land categories with the height of area 201 mdpl(in Urug region, Kawalu District) untill 504 mdpl (in Bungursari region, Indihiang District). The proportion of Tasikmalaya landscape based on the slope generally divided into 3 kinds (regional regulation 2008):

1. land area with the slope more than 17-45% is 10, 85% out of the total land area (most of them in the riverbank and forest).
2. land area with the slope of 9-17% is 17, 56% out of total land area.
3. land area with the slope under 9% is 71, 59% out of total land area.

As a part of Tasikmalaya, based on BPS 2012, Mangkubumi District is in the area with the land slope less than 15% and the land area is 23, 69 km², on 108 degrees east longitude and 107 degrees south latitude on the height of 325-375 above the sea level and it's excluded as a beach area with the average annual precipitation 3, 342, 6 mm.If we see the general term of

INS of SNI 03-2453-2002 that physiological infiltration well manufacture should be in a flat area and based on the physiography data in Mangkubumi District generally as sloping area with slope less than 15%.According to Arsyad, the slope range is 3-8% however according to USSM USLE classification , the area is a sloping area with the slope range is 8-13% if we see from physiography side and it fulfill the condition.It supported by Ayu Wahyuningtyas (2012:28)research that the slope which is appropriate for the infiltration well manufacture is less than 11%.Mangkubumi District is one of the areas that knowns as Sandal industry centre especially in Sambong region, embroidery and stich from bamboo rope.According to the statistic there are 152 home industries in Mangkubumi District. Based on the second general terms in infiltration well manufacture is the raindrop that absorbed to the infiltration well well is not polluted therefore we can summarize that on this aspect, the infiltration well manufacture in Mangkubumi District has fulfilled the terms if we relate it to the environmentally friendly home industries that doesn't make air pollution and mix with the rainfall that reach 3.342, 6 mm/year.

Related to the fourth general terms that infiltration well manufacture should be supported by local government regulation.This thing has been done because the recommendation of infiltration well manufacture is in the regional regulation of Tasikmalaya no.4, 2012 about city planning 2011-2013 article no.43, part 6 poin b page 42.

The management for medium population density housing can be done through the development of infiltration well individually or by group in every development area. The strategy in SSK Tasikmalaya actually as a realisation of Tasikmalaya mission in 2005-2025 that to make Tasikmalaya as a healthy,

comfortable and environmentally friendly (appendix PERDA RJPP 2008). Besides that the infiltration well manufacture supported by development directorate PLD "Dirjen Cipta Karya " Ministry of Public works that the pattern of urban drainage system should be environmentally friendly.

Technical Terms

The infiltration well manufacture can be more effective if it considers not only the general terms but also technical terms before its implementation according to SNI 03-2453-2002. There are three technical terms to make an infiltration well in one area: 1. The minimum depth of ground water is 1, 50 m in the rainy season 2. The land structure has land permeability $>/ 2\text{cm}/\text{hour}$ 3. the ideal distance of infiltration well with the building.

The research result from Riyadi (2005) the condition of ground water in Mangkubumi District varied between 1, 5-7, 30 m under the ground surface with aquifer thickness that contain ground water is 72-92m. Based on the technical terms of the ground water depth that explained before. It can be said that the depth of ground water in Mangkubumi District appropriate to infiltration well manufacture. Land permeable score of infiltration well appropriate based on SNI 03-2453-2002 is more than $2\text{cm}/\text{hour}$. It supported by Suripin opinion (in Ayu Wahyuningtiyas, 2011) that says the appropriate permeability score of infiltration well manufacture range is between $2-12\text{ cm}/\text{hour}$. The research result from Agung Riyadi (2005:370) shows that the land permeability in Mangkubumi District generally is in medium category. With the sediments dominated last as a smooth sand. If we convert this condition to the score of land permeability that used for infiltration well SNI 2002, The land permeability is faster ($6, 5 -12, 5\text{ cm}/\text{hour}$) in another hand if we see the permeability

infiltration well manufacture can be applied in Mangkubumi District.

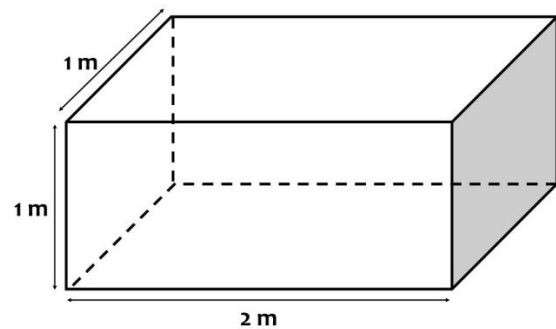


Figure 1. Size of catchment wells on land for shallow groundwater

Determining the general terms and technical terms related to the safety of the local building and ideal distance of infiltration well manufacture therefore it should be experimental discussion. However according to the previous explanation that general terms and technical terms where the land is sloping, unpolluted rainfall, the depth of ground water, supporting permeability score and regional regulation that contain this problem the infiltration water in Mangkubumi District can be applied with land condition adjustment.

Determining the type of infiltration well, dimension construction and the amount of infiltration water that can be build in one area isn't easy because we have to follow the standardized point and adjust the phsysical environment condition, land available and social economy of the local community.

Generally Tasikmalaya has relatively shallow ground water potential as well as in Mangkubumi District according to Agung Riyadi (2005) it's one of unconfined zone with the thickness of aquifer reach 83 meter. The condition of shallow ground water level moderate if this area will make an infiltration well.

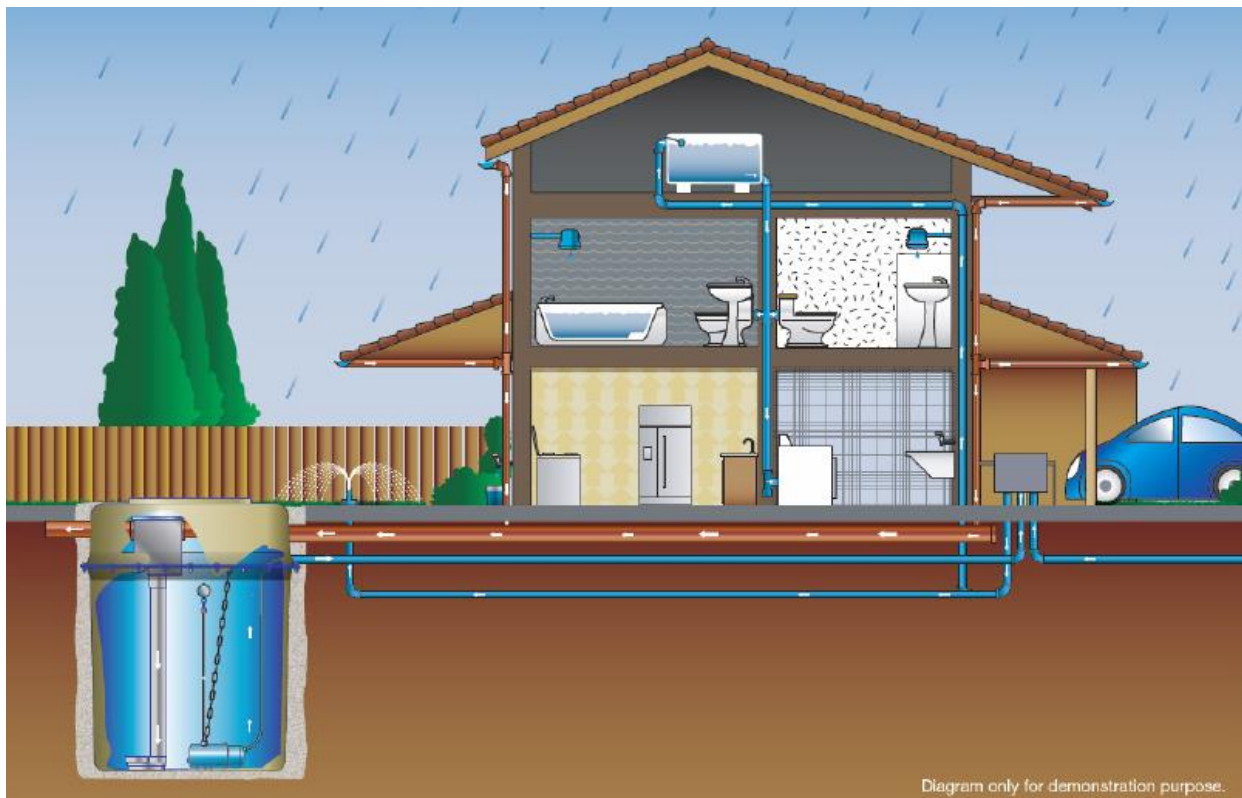
According to Yaser Arafat (2008) the land that has deep ground water surface, the dimension of infiltration well

height is 2m, width 1m and length 1m in another way round for the land that has shallow ground water surface it can be made horizontally with the height of infiltration well only 1 m.

Related to the land condition and shallow ground water surface, the infiltration well manufacture can be applied individually with the model that connected to water channel, for the construction to press the budget, so based on infiltration well manufacture technical guide (Kurnia Iriani, 2013) the type of infiltration well can use type II , the infiltration well with the wall made from adobe and red brick without cement plaster with the hole between them. This type appropriate for every kind of land. One of the examples of infiltration well that can be applied to the shallow ground water surface in many area can be seen in picture 4.3. The shape is round but it's not a big problem and it can be changed to the

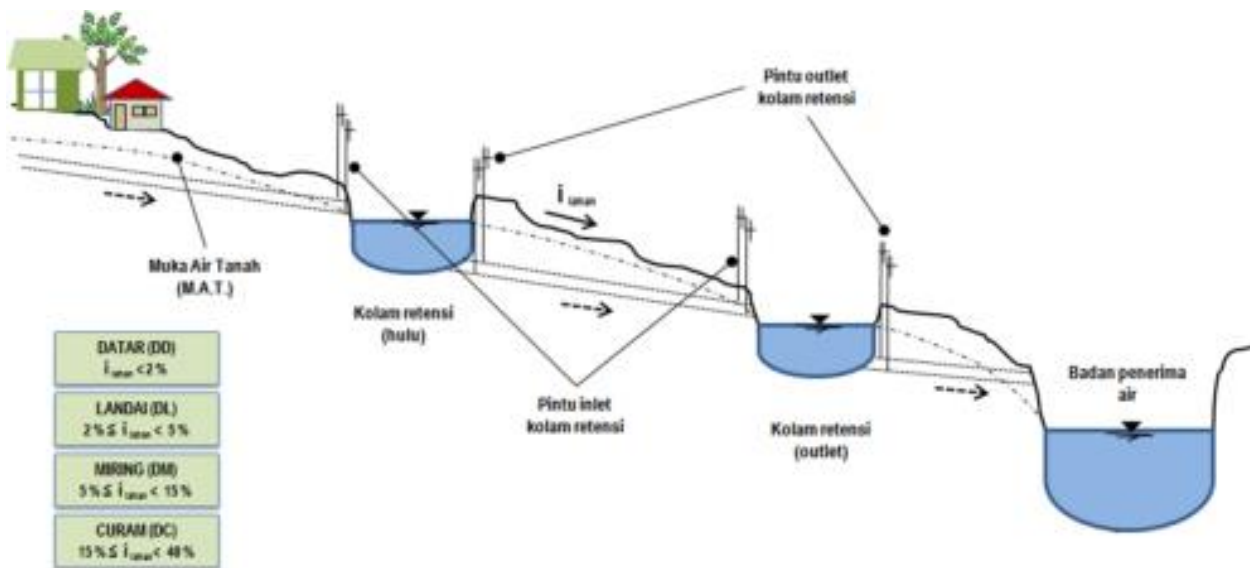
lengthways with the same depth. The lowest part of infiltration model is the poreus covered by fiber, charcoal and sand, besides that to ease the water flow and it also cheap.

condition in Mangkubumi especially if the land isn't flat just like in Situ Gede housing and Abdi Negara retention pool as we can see in picture 4.4. environmentally friendly drainage. From the picture we can see if retention pool is as another type of infiltration that located in sloping area or less than 15%. There are two retention pools with a certain distance that connected to each other. In the first retention pool the excess water can be moved to the 2nd retention pool through the outlet channel and after the 2nd retention pool is overloaded, it can be moved to the water inlet which is micro drainage channel along A.H nasution street as a water receiving body.



<http://www.aquamarinepower.com/>

Figure 2. Infiltration Wells Model in low depth



Source: Dirjen Cipta Karya Pekerjaan Umum

Figure 3. The types of retention ponds of areas not affected by runoff

The amount of infiltration well that can be built

It is not easy to determine the amount of infiltration well because we have to calculate the type and the amount of data. Unfortunately, in this case the researcher cannot get sufficient data to support the determination of the amount of infiltration well needed in Mangkubumi District. However, as an insight for the amount of infiltration well without calculating the pattern can be supported with the table 2.3 on page 14.

Based on the guidance in table 2.3 on page 14, it says that the land area of 50m² for shallow infiltration can be built in infiltration well with the volume of 1m³ and every additional 25,5m² can be added in infiltration water thus as an illustration if it can be applied in one of Mangkubumi housing such as Andalusia with 185 houses from 6 types of house. The kind of house type basically shows that the amount of building area (m²) means if there is 65 type of house therefore in this type only need 1 infiltration well with the volume of 1 m³ and for bigger type such as 184 type. It needs 4 infiltration well. For detail, the amount of infiltration well that can be built in Andalusia housing based

on the type of house or building are table 1 as follow.

Table 1. Number of infiltration wells can be created

No	Type	Wide (m ²)	Total	Number of Infiltration Wells
1	65	84	25	25
2	75	105	20	40
3	85	200	40	80
4	112	200	15	30
5	147	200	15	45
6	184	100	70	280
Total		889	185	500

Source: Supervisor Marketing Andalusia (2014)

Based on the table 1 above, the number of infiltration well that can be built with the volume of 1 m³ is 500 infiltration well that can accommodate 500 m³ rainfall. However in the process of its manufacture there are several things that should be considered. First, the location should be ideal with the most main part of the house which is the septic tank. The minimum distance is 10 meter and the location cannot be lower than the septic tank to avoid the leakage. Second, the amount is varied for every house, for

65 type and 75 type of house can be built communal infiltration well to reduce the land usage. Third, the point of infiltration well is an environmental friendly drainage technology that the main function is to reduce the run off of water that is not good to consume.

The Relationship between Infiltration Well Manufacture with Ecological Intelligence

Infiltration well manufacture as a part of environmentally friendly urban drainage system can be applied not only in community but also in school. The positive aspect for school to introduce and apply environmentally friendly urban drainage system as a learning media to benefit the school yard as a natural laboratory also to train critical behaviour of students to the environment problem especially drainage system so the students ecological intelligence gets better not only from the theory but also for their neighborhood. Hultkrantz, in Sternberg (in Utina, 2009) says that the ecological intelligence practised in behaviour and real habit that consider the ecological capacity and it make a loyalty to the nature so they can be more creative in solving the environment to reach an impressive and dynamic learning process.

One of the subjects that can improve ecological intelligence development at school through the infiltration well manufacture is geography because geography has a strategic part to solve environment problem for a long term. Geography also carry the natural ecology mission besides its relation among geography material object with the three dimension of ecological intelligence. According to Goelmen (in Saputra, 2014), Geosfer dimension is the dimension that includes land condition, water, climate etc. Biosfer Dimension, the dimension that includes human dimension another species and animal

and plant life. Sosiofer dimension, is the dimension that includes residential environment. It related to appendix of Ministry of National Education regulation No.22, 2006, Knowledge, skills and values that can be taken from geogaphy lesson hopefully can build students ability to behave, act smart, wise and responsible in facing social problem, economy and ecology.

In realization, there are some learning model that can be applied related to the discussion of infiltration well, one of them is project learning model, field study or outdoor study. Through the three model of learning, students can learn directly by using environment as a learning source and can put the most student to the learning process activity. In geography, the lesson that related to infiltration well there is a debit calculation in hidrosfer chapter, water flow and ground water characteristic to the available condition of students. Especially if we connect it to the school trend of environmentally friendly or eco school nowadays. Therefore the introduction and application of infiltration well can be done.

CONCLUSION

Infiltration well manufacture as a part of environmentally friendly drainage technology appropriately can be applied in Mangkubumi District based on the general terms and technical condition of infiltration well manufacture that stated by Public Works Department with SNI or Indonesian National Standard 03-2453-2002 permeability score, ground water surface condition and unpolluted rainfall condition, infiltration well manufacture fulfills the terms and condition. Likewise if it's related to the government regulation about infiltration well manufacture in Mangkubumi District supported by regional regulation No.4, 2012 part 43 point 6 b

The weakness of this infiltration well manufacture can be solved by making a shallow infiltration well and retention pool can be built better individually or communally. Saving the cost of infiltration well manufacture construction can be built from red brick or adobe without cement plaster with the basement covered by fiber and sand. Meanwhile, for retention pool can be built communally with the cost that can be support by government and for housing can be support by housing developer. According to the above explanation, infiltration well manufacture in Mangkubumi District can be applied.

RECOMMEDATION

Infiltration well manufacture hopefully can be applied as well at school around Mangkubumi District to increase ecological intelligence. The technique can be integrated with the introduction of environment and geography as a learning material development. Through the practise of infiltration well manufacture, students not only know, sensitive and critical to the condition of environmet which is frequently flood happen but also able to solve the problem.

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