PREPARATION OF INFILTRATION WELL DEVELOPMENT PLANNING IN KADIRI UNIVERSITY AREA

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Abstract
Water leaked into the ground as a result of Indonesia's development, resulting in a reduction of unoccupied land. This results in frequent flooding, such as at Kadiri University in Kediri City, where flood pools are common during heavy rains. Because infiltration wells are so effective and practical, it is vital to develop infiltration wells in the area to overcome this tragedy. At Kadiri University, this research tries to eliminate or eliminate puddles. The Research Method is divided into four stages: primary and secondary data collection, second processing of parametric test distribution data, third water discharge calculation and smirnov kolmogrov test, and fourth determination of infiltration well dimensions. The investigation yielded a pattern of infiltration in the shape of a circular with a diameter of 1.4 meters and a depth of 3 meters, with a total of 153 pieces. The presence of infiltration wells is projected to lessen puddles on campus in the future.

Keyword : Flood, Infiltration Well, Kadiri University

INTRODUCTION

As the population grew, densely crowded homes had to be rebuilt[1]. The land's ability to absorb water will be reduced if development becomes more widespread [2]. This absorption is critical for flood management and preserving water availability in surface waters. [3][4]. This type of absorption is referred to as infiltration [5].

Droughts in some locations can be overcome with the existence of infiltration wells [6]. It can also protect a healthy environmental ecology, such as clean air, healthy trees, and enough water for animals, among other things [7][8]. Furthermore, the soil can be fertile and used by farmers for agricultural [7][9].

There are still portions in Kediri that have been overwhelmed with water [10]. Drainage systems that need to be improved on a regular basis will consume a significant amount of funds [11]. In one of Kediri's cities, there is a Kadiri University campus that is constantly monitored for puddles when it rains. Infiltration wells are needed on the Kadiri University campus in Kediri City's Mojoroto District to aid water infiltration into the ground.
As a result, in order to restore the environment's function and overcome flooding at Kadi University, infiltration wells must be built, which will be an effective approach to do so.

**LITERATURE REVIEW**

Infiltration wells are one of the water absorption mediums for temporarily holding water in the water surface flow so that fresh water can be kept [12]. It can increase water utilization and capacity to meet the needs of living organisms[13],. One of the water conservation methods in soil replenishing is this stage[14] [15]. The conservation is known as an infiltration well, and it is man-made for a variety of reasons, including 1) groundwater resource preservation, environmental quality enhancement, and environmental awareness cultivation. 2) Assist in the fight against the lack of safe drinking water. 3) Maintain the soil's water balance. 4) Reduce soil erosion and surface runoff.

The technical data of water infiltration wells were set as follows by Ditjen Cipta Karya Ministry of Public Works [13], 1) A diameter of 1.4 meters is included. 2) The pipe diameter that enters is 110 mm. 3) 1.5 to 3 meters in depth 4) 1:4 sand cement mixture 5) Stone with a depth of 40 cm and a diameter of 20/20. 6) Cover with a variety of materials, 1 of cement, 2 of sand, 3 of gravel Furthermore, based on SNI No. 03-2453-2002, among other things, [13]: 1) The positioning is level. 2) it's not filthy 3) dependable 4) Minimum depth: 1.5 m; permeability of Nilai soil: 2.0 cm/h. Permeability is divided into three categories: 1) Medium permeability (lanau), i.e. 2.0 – 3.6 cm/h or 0.48 – 0.864 m3/m2/day; 2) Rather fast permeability (fine sand), i.e. 0.864 m 3.6 – 36 cm/h or 0.864 – 8.64 m3/m2/day; 3) Fast land permeability (rough sand), i.e. greater than 36 cm/h or 8.64 m3/m2/day.

Calculating discharge and parameter testing is required in parametric analysis. At the very least, data from the previous ten years was used [13]. Table 2 lists the parameters utilized in frequency analysis calculations.

| Table 1. Frequency Analysis Statistics Parameters |
|-------------------------------------------------|
| Parameter | formula | Parameter | formula |
|-----------|---------|-----------|---------|
| Rata-rata (Xrerata) | I/n, ∑n i=1 X_i | Standard deviation (s) | √(∑n i=1(xi - xrerata)^2) / (n - 1) |
| Coefficient of variation (Cv) | Cv = s / x rerata | Koefisien kewness (Cs) | n, ∑n i=1(xi - xrerata)^2 / (n - 1)(n - 2)^3 |
| Koefisien kurtosis (Ck) | n^2, ∑n i=1(xi - xrerata)^4 / (n - 1)(n - 2)(n - 3)s^4 |

In determining the distribution method, there are requirements that must be met according to the table below [13]:

| Table 2. Statistical Parameters for Determining Distribution Types |
|----------------------------------------------------------|
| No | Distribution | Requirement |
|----|--------------|-------------|
| 1  | Normal       | x ± s = 68.27%, x ± 2s = 95.44%, C_v ≈ 0.0, C_k ≈ 3.0 |
| 2  | Log Normal   | C_v = C_v - 3C_v, C_k = C_v + 6C_v + 15C_v + 16C_v + 3 |
| 3  | Gumbel       | C_v ≈ 1,396, C_k ≈ 5,4002 |
| 4  | Log Person III | If it doesn’t reveal the characteristics of the three distributions above, it’s not a good indicator. |

Using formulas, calculate rain using multiple approaches for the current year [16][17]:

1. Normal distribution type: XT = x + KT. s
2. Normal Log distribution type: log XT = log x + KT. s
3. Pearson Log Distribution Type III log XT = log x + K. s

4. Gumbel distribution type: XT = x + s. K

Where: XT = sample average price year, X = probability factor probability factor (from Gauss Reduction Table), s = standard deviation, K = rain draft period T.
Rainwater infiltration wells are calculated in accordance with SNI No. 03-2453-2002, and are divided into two parts: 1. the amount of rainwater that falls onto the field tanah and is released into the rainwater infiltration well. Formulas that were employed [13] [18]:

1. Volume of Flooding
\[ V_{ab} = 0.855 \times C_{tadah} \times A \times R \]
Where: \( V_{ab} \) = volume of flood contribution to be accommodated infiltration wells (m³), \( C_{tadah} \) = coefficient of runoff of the field of raindrops (without units), \( A \) = area of raindrops field (m²), \( R \) = average daily rain height (L/m²/day).

2. The volume of rainwater is pervasive, the following formula is used:
\[ V_{rsp} = \frac{te}{24} \times \text{Total.} \times k \]
Where: \( V_{rsp} \) = volume of pervasive rainwater (m³), \( te \) = effective rain duration (hours), \( A_{total} \) = area of well wall + area of well base (m²), \( k \) = coefficient of soil permeability (m/day) (for impermeable well walls, \( k_v \) value = \( k_h \). For non-impermeable walls, the average value is taken).

3. Rainwater storage volume \( V_{storasi} = V_{ab} - V_{rsp} \) [19]

4. \( H_{total} = \frac{V_{ab} - V_{rsp}}{A_{h}} \), where : \( n = H_{total} / H_{rencana}, n \) = number of infiltration wells

**RESULT AND DISCUSSION**

The first step in this investigation is to calculate the area of each building using the diagram below. When using a ruler scale of 10 m = 0.8 cm, write 10 m in 0.8 cm: 1000 cm, and 1 cm: 1250 cm. As a result, every 1 cm represents 12.5 m. Then produced the area of building A: 625 m², building B: 546.875, building C: 351.5625, building D: 703.125 m², building E: 1406.25 m², building F: 351.5625 m², building G: 1500 m², building H: 1171.875 m², building I: 2187.5 m².

**RESEARCH METHOD**

Surveying locations prone to flooding during rain was used as part of the research technique. Kadiri University is an observation location in Kediri City's Kec. Mojoroto. This survey was conducted when it rained, resulting in puddles due to a lack of water suction force into the earth.

1) Primary data collection with direct termination, 2) secondary data gathered from the Office of Pu kediiri's Rainfall Data for the previous ten years. Secondary data collection comes from books and journal sets. 3. Processing rainfall data with normal distribution, Normal Log, Gumbel, Log person III, 3) Calculating water discharge period Research 5 years, 4) Test Smirnov Kolmogorov, 5) Determination of dimensions and number of sage resapan

**Figure 2. The Roof Area Code of each Campus building calculated**

The graph below depicts the recapitulation of maximum rainfall data from 2011 to 2020.

**Figure 3 Rainfall maximums from 2011 through 2020**

Distribution selection tests are carried out in the third stage. The following are the stages of conducting such an analysis:

1. Mean of mean \( X = \frac{\sum x}{n} = \frac{966}{10} = 96.6 \)
2. Calculating standard deviation \( S = (7163.04 / 10-1)^{0.5} = 26.57 \)
5. Calculates the coefficient of variation (CV) = \( \frac{S}{\text{average } X} = \frac{26.57}{96.6} = 0.275 \)
6. Calculates the asymmetry coefficient (CS) = \( \frac{(10-1) \times (10-2) \times (26.57)^3}{113966.13} = 0.843 \)
7. Calculating the coefficient of kurtosis (CK) = \( \frac{10}{((10-1)x(10-2)x(26.57)^4)} \times 10431690.64 = 2.91 \)
8. Calculating comparison CS:CV = 0.843 : 0.275 = 3.065

The following calculation can be seen in the distribution selection table:

Table 3. Test of Distribution Selection

| No. | Tahun | Xi  | (Xi - Xrt) | (Xi - Xrt)^2 | (Xi - Xrt)^3 | (Xi - Xrt)^4 |
|-----|-------|-----|------------|--------------|--------------|--------------|
| 1   | 2011  | 84  | -12.57     | 158.00       | -1986.12     | 24965.55     |
| 2   | 2012  | 77  | -19.57     | 382.98       | -7495.01     | 146677.43    |
| 3   | 2013  | 87  | -9.57      | 91.58        | -876.47      | 8387.79      |
| 4   | 2014  | 121 | 24.43      | 596.82       | 14580.43     | 356199.96    |
| 5   | 2015  | 71  | -25.57     | 653.82       | -16718.30    | 427487.00    |
| 6   | 2016  | 129 | 32.13      | 1032.34      | 33168.98     | 1065719.48   |
| 7   | 2017  | 78  | -18.57     | 344.84       | -6403.77     | 118918.01    |
| 8   | 2018  | 63  | -33.57     | 1126.94      | -37831.54    | 1270004.81   |
| 9   | 2019  | 148 | 51.43      | 2645.04      | 136034.66    | 6996262.52   |
| 10  | 2020  | 108 | 11.43      | 130.64       | 1493.27      | 17068.09     |
| Sum |       | 966 |           | 7163.04      | 113966.13    | 10431690.64  |
| Average x | 96.57 |
| n    | 10    |
| S    | 28.21 |
| Cs   | 0.70  |
| Ck   | 3.27  |

The terms of frequency selection according to the gumbel method's rules must be smaller than Ck < 5.4002 and Cs < 1.1396, then the normal method with the values Ck = 3 and Cs = 0, and the normal method with the rules Ck = 3 and Cs = 0 According to the following calculation for the gumbel method:

Table 4. Gumbel Distribution

| No. | Year | Rainfall (mm) | X - X_average |
|-----|------|---------------|---------------|
| 1   | 2011 | 84.00         | -12.57        |
| 2   | 2012 | 77.00         | -19.57        |
| 3   | 2013 | 87.00         | -9.57         |
| 4   | 2014 | 121.00        | 24.43         |
| 5   | 2015 | 71.00         | -25.57        |
| 6   | 2016 | 128.70        | 32.13         |

7 | 2017 | 78.00 | -18.57 |
8 | 2018 | 63.00 | -33.57 |
9 | 2019 | 148.00| 51.43  |
10| 2020| 108.00| 11.43  |

Sum | 965.70 |
Average | 96.57 |
Standart Deviasi | 28.21 |

n | 10 |
Yn | 0.46 |
Sn | 0.95 |

The cs value, CV, and CK only qualified in the normal log based on the preceding analysis, hence distribution log person III was chosen. Then, with the following computation, complete the log person calculation.
Table 5. Person Log Distribution

| No | Xi  | Log Xi | (Log Xi - Log X) | (Log Xi - Log X)^2 | (Log Xi - Log X)^3 |
|----|-----|--------|------------------|-------------------|-----------------|
| 1  | 84  | 1.924  | -0.045           | 0.002             | 0.000           |
| 2  | 77  | 1.886  | -0.082           | 0.007             | -0.001          |
| 3  | 87  | 1.940  | -0.029           | 0.001             | 0.000           |
| 4  | 121 | 2.083  | 0.114            | 0.013             | 0.001           |
| 5  | 71  | 1.851  | -0.118           | 0.014             | -0.002          |
| 6  | 129 | 2.110  | 0.141            | 0.020             | 0.003           |
| 7  | 78  | 1.892  | -0.077           | 0.006             | 0.000           |
| 8  | 63  | 1.799  | -0.170           | 0.029             | -0.005          |
| 9  | 148 | 2.170  | 0.201            | 0.041             | 0.008           |
| 10 | 108 | 2.033  | 0.065            | 0.004             | 0.000           |
| Sum| 965,70 | 19.69 | 0.00             | 0.14              | 0.01            |
| Average| 96,570 | 1.969 |                  |                   |                 |
| Standard Deviation | 28,212 | 0.123 |                  |                   |                 |
| Cs  | 0,705 | 0,380 |                  |                   |                 |

Log person calculation above has the following stages: Average rain (Log average X) = \( \frac{\sum \log x \times 19.69}{10} = 1.969 \). Standard deviation calculation \( S = \frac{(0.14/10 - 1)^0.5}{0.5} = 0.125 \). Calculation of asymmetry coefficient (CS) = \( (10 \times 0.01)/(10 - 1) \times (10 - 2) \times (0.125)^3 = 0.71 \). For the price CS = 0.71 from the table of frequency factors log person III get a k value from the 25 yearly re-period of 1,967 and so on according to the table. Based on SNI No. 03-2453-2002 [18] in the planning of rainwater infiltration wells used is a 5-year re-period, so for further calculations using daily draft rain (R24) of 116.8826 mm/day. The result of smirnov kolmogrov with a value of 10, Dcr = 0.41 with a=5% and Dcr = 0.49 with a=1%. Because Dcr calculates < Dcr table = 1.02 > 0.49 then the distribution is rejected.

Here is one of the calculations in determining the infiltration well of building A = 625 m². Assumption of coefficient value for roof 0.8[20]. Vab = 0.855. C tadah. A tadah. R = 0.855. 0.8 . 625 . 116.8826 = 49953.7 L = 49.9673115 m3. 1). If it is assumed that the cross-section of circle D well = 1.4 m and H plan = 3m. If it is assumed that the cross-section of circle D well = 1.4 m and H plan = 3m. 2) Furthermore, the calculation of the volume of rainwater that permeates \( tc = 0.9. \ R^{0.92} / 60 = 0.9. (116.8826^{0.92}) / 60 = 1.197901569 \) hours. 3) Well area (Asumur) = Wall area + Base area = \( (1/4 \pi x D^2) = (\pi x 1.4 x 3) + (1/4 + \pi x 1.4 x + 1.4^2) = 17.998 \) m³. 4) The value K is taken from (assumption of permeation using paving + compaction = medium permeability) = 2 cm / h or 0.48 m³/m²/day. 5) Infiltration volume obtained from (Vrsp) = (tc/24) x A total well x k = (1.197901569/24) x 17.998 x 0.48 = 0.431 m³. 6) Volume of rainwater reservoir V storasi = Vab – V rsp = 49.9673115 - 0.431 = 49.5363115 m³. 7) Total height H = (Vab - V rsp) / Ab = 49.5363115 / (\pi x 0.7 x 0.7) = 32.2. 8) Number of infiltration wells = H total / H plan = 32.2 / 3 = 10.7 = 11 with D = 1.4 m and H plan 3m. Further calculation can be forwarded to building B with the number of infiltration wells 11 pieces, building B: 10 pieces, building C: 6 pieces, building D: 12 pieces, building E: 24 pieces, building F: 6 pieces, building G: 26 pieces, building H: 20 pieces, building I: 38 pieces.

According to the previous research, the results of the calculation of one house covering 100 m² using a 3 m infiltration well depth can be compared to the results of the calculation of one house covering 100 m² using a 3 m infiltration well depth.

CONCLUSION

The number of wells with dimensions of D: 1.4 m and a depth of 3 m was determined to be 153 pieces. With the completion of this research, Kadiri...
University should be able to reduce standing water during rainstorms.

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