Planning Of Drainage Channel Dimension In The Core Zone Of Muara Takus Temple

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Abstract: Preservation of Cultural Heritage is a dynamic effort to maintain the existence of cultural heritage by protecting, developing, and utilizing the cultural heritage in the contemporary context. To protect the cultural heritage in term of conservation called protection of which the effort to prevent and overcome from damage, it needs to do destruction or obliteration through rescue, security, zoning, maintenance, and restoration of cultural heritage. The most fundamental issue is the hydrological impact of the existence of Hydroelectric Power Koto Panjang located around Muara Takus temple that could threaten the sustainability of the region. In this case, hydroelectric dam frequently causes Kampar Kanan River overflowed thus potentially floods, especially in the rainy season that could eventually submerge Muara Takus area. The total area of the region Muara Takus enshrinement is ± 94.5 hectares that are divided into two main parts. Those are the terrestrial land of ± 56.44 m², and PLTA Koto Panjang lake of ± 38.06 m². Consequently, it is necessary for drainage planning of economical dimension in the core zone of Muara Takus temple. Furthermore, from the data of the maximum rainfall of 101 mm/ day obtained a discharge of rainfall of 0.38 m³/ second so that this discharge of rainfall can be designed drainage channel dimension to accommodate the discharge of rainfall. From the analysis of dimension designed drainage is the size of 30 cm x 45 cm. this dimension can accommodate the discharge rainfall that is equal to 0.43 m³ / second. Regarding the finding, it can be concluded that the discharge of rainfall that occurred less than discharge calculation of dimensional analysis of drainage channel so that the size of this dimension can accommodate discharge rainfall occurs.

Keywords: Muara Takus Temple, Discharge, Channel Dimension

1. Introduction
Muara Takus Enshrinement of cultural heritage viewed from the geographical location, has a very strategic layout, i.e. in the middle of the cruise lines trade between India and China. Therefore, it has become a liability to the people of Indonesia as his successor to attempt to preserve it. However, the activity of preservation is not an easy thing. Various issues must first be identified so that the concept of preservation can be designed accordingly. The observation in the field showed that the existence of two things that need to be taken into account in the planning of preservation, that is associated with the presence of cultural heritage Muara Takus Enshrinement and social issues. The economy and culture are estimated to be a challenge or obstacle to doing preservation.
The most fundamental issues in the area of Muara Takus temple complex is about the hydrological impact of the existence of Koto Panjang Hydroelectric Power Plant (PLTA) located around the Muara Takus temple that can threaten the sustainability of the area. PLTA dams often cause Kampar Kanan River overflowed thus potentially flooding, especially in the rainy season which could eventually sink the area of Muara Takus Enshrinement. The total area of Muara Takus Enshrinement area is ± 94.5 hectares. Land use in the Muara Takus Temple area is divided into two main parts, ie terrestrial land of ± 56.44 m², and PLTA Koto Panjang lake of ± 38.06 m².

The existence of a pool of reservoirs which almost surrounds the entire complex, only about 16% of the circumferences of the complex are not inundated in water reservoirs face elevation 85 m above sea level. In addition, the drainage conditions around the temple complex that are still no existence. Therefore, it is necessary to have a suitable drainage design applied in the temple complex and the appropriate drainage dimension.

2. Literature Review

2.1. The concept of Site Preservation
Conservation is a dynamic effort to preserve the existence of the Heritage and its value by protecting, developing and utilizing it. Protection is an effort to prevent and cope with damage, destruction, or obliteration through rescue, security, zoning, maintenance, and restoration of cultural heritage. The terms of protection discuss in the following.

1) Rescue is an effort to prevent and/or to cope with cultural heritage from damage, destruction, or ruin.
2) Security is an effort to maintain keeping cultural heritage and to prevent from threats and/or disruption.
3) Zoning is the determination of the boundaries of the spatial site of cultural heritage and the heritage area according in accordance with needs.
4) Maintenance is the effort of keeping and caring for the physical condition of cultural heritage in order to remain sustainable.
5) Restoration is the attempt returns the physical condition of objects of cultural heritage, Heritage Buildings and structures damaged cultural heritage in accordance with the authenticity of the material, shape, layout and/or machining techniques to prolong its age.

The site of Muara Takus Enshrinement seemed prepared also as a well-planned settlement. As the boundaries of settlements made land dikes that serve as a fortress, therefore the area of this site was once known as Koto which means the Benteng. The land surface elevation is a reference elevation of this site is 86.5 m above sea level, higher than 1.5 m from the stakes made by Koto Panjang Hydroelectric ie at 85 m above sea level.

In the site there are buildings that are used for religious purposes as well as non-religious interests. The largest religious building is called Muara Takus Temple. The building that is not for religious interest can be known from the foundation ruins, such as the excavation from 1985, the building of the excavation by Balai Pelestarian Cagar Budaya Batusangkar, and new findings of the excavation of Balai Medan. It is estimated that there is archaeological data now in the Koto Panjang hydropower lake that cannot be traced back.

2.2 Drainage
The word drainase comes from the word drainage which means to dry or drain. Drainage is a system designed to deal with the problem of excess water both excess water above the surface ground and water under the surface ground. Drainage has several types. They are:

1) Based on the way of formation of drainage

Types of drainage on the basis of how the formation, can be grouped into:

a. Natural drainage; Natural drainage is formed through a long-lasting natural process. Drainage channels are formed by water scouring according to the soil contour. This natural drainage is formed on soil conditions sufficient slope, so the water will flow by itself, into the rivers. On the ground are quite porous, water on the surface of the soil will soak into the ground (infiltration). The water that seeped turned into a stream between (sub-surface flow) flows to the river, and can also flow into the ground (perlokasi) up to groundwater which then together with the groundwater flow as a stream of ground water (ground water flow) to the river. Generally this natural drainage of a River along with its tributaries that form a network of river channels.
b. Artificial Drainage; Artificial drainage is a system made with a specific purpose and is the result of engineering based on the results of the calculations performed for efforts to perfect or complete the lack of natural drainage system. At require artificial drainage system costs both in planning and in making.

2). Drainage based on the layout; This type of drainage is reviewed based on its layout, can be grouped into:
   a. Surface Drainage; Surface drainage is drainage channel system is above the soil surface water drainage occurs because of the height difference of the surface of the channel (slope).
   b. Subsurface drainage; Subsurface drainage is a drainage system that flowed underground (grown) usually for artistic system or in an area that does not allow it to drain the water above the ground as on the sports field, airports, parks and more.

3). Drainage based on its function; Type of drainage based on its function, can be grouped into:
   a. Single Purpose Drainage; Single purpose drainage is a drainage channel that functions to drain one type of water such as rain water or waste water or other.
   b. Multi-Purpose Drainage; Multi-purpose drainage is a drainage channel that functions to drain more than one waste water either mixed or alternately e.g. mixture of rainwater and waste water.

4). Drainage based on its construction; The type of drainage reviewed based on its construction can be categorized as:
   a. Open Channels Drainage; Open drainage is a drainage system whose surface water is affected by the outside air (atmosphere). Open drainage usually has a sufficient area and is used to drain rain water or wastewater that does not endanger the health of the environment and does not interfere with the beauty.
   b. Closed Channels Drainage; Drainage of closed channels is a system of channels whose surface water is not affected by the outside air (atmosphere). Closed drainage channels are often used to drain wastewater or dirty water that interferes with environmental health and disrupts beauty.

3. Research Method
This research employed field survey method, namely conducting the research through observing the geographical condition of complex area of Muara Takus temple directly. Muara Takus Temple Site is administratively located in Muara Takus Village, District XIII Koto Kampar, Kampar District, Riau Province. In astronomical site is located at position 0º20'9,7 “LU and 100º38'31,3” BT, and topographically situated in a hilly area with a weak wave height of ±86.5 meters. To design this drainage dimension required some data that must be obtained such as:

3.1 Flow capacity due to rain
The rain that occurs causes the rainwater that possibility, largely stagnant and flowing on the ground surface (run off) and a small sink in (infiltration) into the subsoil. If the surface of the soil occurs greater inundation of infiltration, then to stream water drainage used advance land. Maximum flow (discharge) capacity is analyzed by rational method:

\[ Q = \alpha \cdot \beta \cdot I_t \cdot A \]  

where:
\[ Q = \text{flow debit (m}^3/\text{second)} \]
\[ \alpha = \text{Coefficient of run off} \]
\[ \beta = \text{Coefficient of rain dispersion} \]
\[ I_t = \text{Rain intensity} \]
\[ A = \text{area} \]

3.2 Coefficient of run off (\( \alpha \))
It is categorized becomes: The run off coefficient is the comparison between the rainy part that ran on the earth with the total rainfall. The run off coefficients are mostly intermediate, but preferably for analysis, the largest or maximum value is used. Where the run off value is as follows in accordance with the existing land use.
The steep mountains
Bumpy land and Forest
Cultivated plains
Waterproof roof
Asphalt Pavement and concrete
Soil solid, hard to be infused
The soil is rather easily impregnated
Park / open field
Garden
Housing is not so tightly
(20 houses/hectares)
Medium density housing
(21 - 60 houses/hectares)
High density housing
(61 - 160 houses/hectares)
Recreational Area
Industrial Area
Commercial Area

| Land Area (km²) | Koefisien β |
|----------------|-------------|
| ≤ 4            | 1           |
| 5              | 0.995       |
| 10             | 0.980       |
| 15             | 0.955       |
| 20             | 0.920       |
| 25             | 0.875       |
| 30             | 0.820       |
| 50             | 0.500       |

3.3 Coefficient of Rain Dispersion (β)

The rain-dispersion coefficient depends on the area of the rain-fed region according to the study area. The coefficient of rain dispersion can be seen in the following table:

\[ \text{It} = \frac{R}{24}(24/t_c)^{0.3} \]

where:

- \( \text{It} \) = Rain intensity
- \( R \) = Duration, rainfall
- \( T_c \) = Time concentration

3.5 Channel Dimensions

The flow capacity due to rain should be drained through the drainage channel to the point of downstream planning. Rainfall discharges are analyzed to become volumetric flow to make the channel dimension.

\[ Q_{\text{Rain}} = Q_{\text{Channel}} = F_s \cdot v \]
Fs = Channel Design
v = Speed of water flow in the channel
to analyze the speed of water flow determined based on Manning atau Chezy formula:

**Manning Formula:**
\[ v = \frac{1}{n} \cdot R_s^{2/3} \cdot I^{1/2} \] ...........................(4)
where:
- \( v \) = Speed of water flow in the channel (m/second)
- \( n \) = Coefficient of wall roughness
- \( R_s \) = Hydraulic radius = Fs/Ps (wide channel /Channel wet circumference)
- \( I \) = Slope channel plan

**Chezy Formula:**
\[ v = C \sqrt{R_s \cdot I} \] ...........................(5)

Coeficient of Chezy:
\[ C = \frac{100 \sqrt{R_s}}{(0,35 + \sqrt{R_s})} \]
\[ v = \frac{0,35 + R_s^{1/2}}{0.35+R_s^{1/2}} \] ...........................(6)
where:
- \( v \) = Speed of water flow in the channel (m/second)
- \( R_s \) = Hydraulic radius = Fs/Ps (wide channel /Channel wet circumference)

### 4. Findings and Discussion
Based on the results of field surveys Muara Takus temple complex area directly adjacent to Kampar River, Thus, flow of water around Muara Takus temple complex was to be large and easily flooded. So, it is necessary an action of countermeasures the large water discharge so as not to inundate Muara Takus temple complex that is by designing the drainage channel in the temple complex.

#### 4.1 Analysis of Drainage Channel Dimension
Data obtained from that maximum rainfall in the region of the Temple of muara takus i.e. \( R = 101 \) mm/day. With an area of \( 94.5 \) Ha = 0.945 km²
to find the discharge by using this formula:
\[ Q = \alpha \cdot \beta \cdot I_t \cdot A \]

So, from the result of field survey obtained score:
\( \alpha \) Data from the area around the temple was a plantation area \( \alpha = 1 \) obtained from land area < 4 km² where the data was obtained from all of land area of temple which was 94.5 Ha = 0.945 km²
\[ I_t = \frac{(R/24)}{(24/tc)^{3/2}} \]

Where:
- \( R = 101 \) mm/day = 0.0042083 m/hours
- \( tc = \) Seen from channel slope table

| Channel Slope I (%) | Average Speed v (m/second) |
|---------------------|---------------------------|
| < 1                 | 0.40                      |
| 1 - <2              | 0.60                      |
| 2 - <4              | 0.90                      |
| 3 - <6              | 1.20                      |
| 4 - <10             | 1.50                      |
| 5 - <15             | 2.40                      |
So, seen from the topographic map, it can be said that the level of slope from complex area in candi muara takus temple is <1% so the value of \( v = 0.40 \) m/ second so that the value of \( tc = 20 \) seconds
\[
\begin{align*}
I_t &= \frac{(R/24)(24/tc)^{2/3}}{24/tc} \\
&= \frac{(101/24)(24/20)^{2/3}}{24/20} \\
&= 2.02
\end{align*}
\]
\[
Q = \alpha \cdot \beta \cdot I_t \cdot A
\]
\[
= 0.2 \cdot 1 \cdot 2.02 \cdot 0.945
\]
\[
= 0.382 \text{ m}^3/\text{s}
\]
So that the dimension of cross-sectional surface drainage to around the pedestrian path is made rectangular dimension by using formula:
\[
Q = F_s \cdot V
\]
\[
v = \frac{1}{n} R_s^{2/3} I^{1/2} \quad (\text{m/s}) \text{ manning}
\]
\[
R_s = \text{Hydraulic radius (Fs/Ps)}
\]
\[
F_s = \text{Wet cross-sectional area}
\]
\[
P_s = \text{Circumference of wet cross section}
\]
\[
I = \text{Channel slope}
\]
\[
\text{Where the slope of channel made } 2\%
\]
\[
v = \frac{1}{(1/0.018)} (Rs)^{2/3} \cdot (0.02)^{1/2}
\]
\[
= \frac{1}{(1/0.018)} (Fs/Ps)^{2/3} \cdot (0.02)^{1/2}
\]
\[
= \frac{1}{(1/0.018)} \cdot (0.135/1.05)^{2/3} \cdot (0.02)^{1/2}
\]
\[
= 0.313
\]
By using a trial error then obtained the drainage dimension is 30 cm x 45 cm
\[
Q = F_s \cdot v
\]
\[
= 1.350 \cdot 0.313
\]
\[
= 0.43
\]
So Q rainfall < Q dimension calculation
\[
0.38 < 0.43
\]
So the drainage dimension used 30 cm x 45 cm can accommodate existing rainfall that is 0.38 m3/s

5. Conclusion and Suggestion
From the survey results and data analysis obtained the size of the drainage dimension that can accommodate the discharge of rainfall is the size of 30 x 45 cm rectangular shaped under it is given an absorption hole.

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