18. UPGRADING A CANAL SYSTEM FOR TAN SON RESERVOIR, GIA LAI PROVINCE, VIETNAM

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Recently, Vietnam is a developing country in the period of integration. The buildings are growing more and more effectively, in which irrigation is an important aspect in the development of economic, politics and society. So, a significant issue to set-up construction of irrigation project for outlying areas of the water service. The main aims of this report are to introduce the project in detail and to show the calculation and evaluation results of our group for adjustment. It is also helpful for other students in agricultural hydraulic engineering in order to find reference materials because we have followed the right process of updating an irrigation system in reality. The manager in Gia Lai province may also pay attention on the project to turn it into practice. . All hydraulic calculations to find out discharge and water using coefficient of the irrigation system is shown in chapter 2. Chapter 3 provides you the process how our group chooses the solution to the project. After that, all calculations for designing are given in the next chapter. Finally, you can find the cost for the project as well as environment impacts and conclusion in the later chapters.

Key Words : *longitudinal cross-section, horizontal cross-section, self-irrigation elevation.*

1. INTRODUCTION

(1) Study area ‘s characteristics

Tan Son is a reservoir planes to construct at Ia Ro Nhinh stream of Nghia Hung communes - Chu Pah district, a region in the North of Viet Nam.This is a head work construction which layout 17km from the Pleiku city, following the high-way to East – North with the geographical position. This project is located in a tropical monsoon weather with two distinguish seasons:Dry season from December to March and Wet season from May to November. During the wet season with high intensity rainfall starts from June to August is accounted for 90% of total .

(2) Current situation

The production area has own favorable condition to develop agricultural: an even and flat terrain, thick farm land, high fertility, good climate, etc. Tan Son reservoir system with the old canal system does not supply enough water for domestic and agriculture; production zone still depend on nature. Thus, One part cultivable land is irrigated, the remaining agricultural land is depended on rainfed water and is one cropping season.

(3) Project necessity

Upgrading the canal system is to improve the farming seasons, expand area under cultivation : total 450ha with 3 beneficial areas

2. UPGRADING THE CANAL SYSTEM

(1) Overview

It is necessary for strengthening the canal system in view of economic, technical, and environment because we want increase farming area, quantity and quality of the products, decrease O & M cost, save water sources from water losses during water conveyance process, contribute to the convenience for local traveling through the traffic along the canal bank, and contribute to improve the area landscape

(2) Selection of cross-section

There are several cross-sections that we can take into account. For example: Trapezoid; rectangular; isosceles trapezoidal with a straight line b in the bottom connected to a segment of circle; parabola; square; etc.. Each cross-section has own advantages and disadvantages, but depends on the conditions of study area the structure of canal, and the criteria of canal improvement , we decide to choose trapezoidal cross section for the main canal and rectangular cross section for the secondary canals. For the materials, we choose concrete blocks, cast in place concrete, lean concrete for main canal and choose lean concrete and cast-in-place concrete for the secondary canals

3. Basic design for the canal system

To upgrade a canal system , we need to follow these steps:

Step 1: Draw longi**tudinal cross section of natural line**

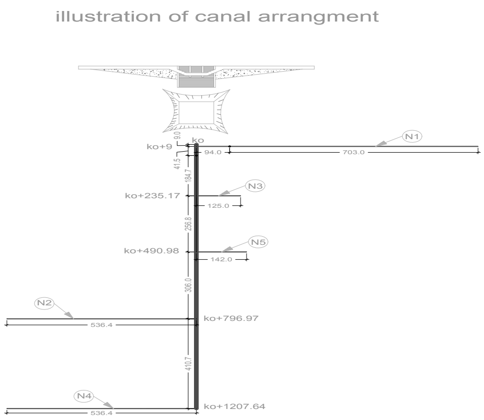

Fig. 1 Canal distribution

Step 2: Determine the self-irrigation elevation at the head of each canal

To calculate the self -irrigation elevation , we need to use the formula

$$\nabla_{required} = A_0 + h + \sum l * i + \sum \varphi \quad (1)$$

Where

A_0 : The elevation of required water level controlled at a rice field.

h : Water level at the field

$\sum l * i$: Sum of water losses along the canal (l; i are length and slope of each canal segment)

$\sum \varphi$: Sum of losses on canal structures

Step 3: Determine slope of the canal base on soil characteristics and discharge in the canal.

Table 1 Results of the canal system

No	Canal	i
1	N1	0.003
3	N3	0.001
5	N5	0.002
2	N2	0.004
4	N4	0.003
5	K0-K0+9	0.002
6	K0+9-K0+235.17	0.003
7	K0+235.17-K0+490.98	0.004
8	K0+490.98-K0+796.97	0.003
9	K0+796.97 - K0+1207.64	0.002

Step 4: Draw designed water level line

Base on the ground surface and the required water level control of feeder canal, we draw the water table level that satisfy the following conditions: try to cover all the required water level control, appropriate with the natural ground surface due to excavation and fill volume minimum, it has longitudinal slope in the range of i_{max} and i_{min} $(i_{\min} < i < i_{\max})$ by using **Table 1**

Step 5: Determine cross section area b, h

$$Q_{net} = q * A \quad (2)$$

Where: q is the irrigation coefficient

A is the irrigation area

$$Q_{brut} = Q_{net} / \eta \quad (3)$$

η can be found by using VNTC 4118-85 (page 38)

$$Q_{brut} = Q_{net} + Q_{loss} \quad (4)$$

With

$$Q_{loss} = (l * A * Q_{net}^{(1-m)}) / 100 \quad (5)$$

Where: l is the length of the main canal segment

A,m are the coefficients that can be found depend on soil permeability from table 9.1 in text book "Irrigation System Planning and Design"

Calculate the water requirement coefficient of the canal system

$$\eta = (\sum q * A) / Q_{brut} \quad (6)$$

Calculate the maximum discharge and minimum discharge determine longitudinal section of main canal

$$Q_{\max} = k * Q_{design} \quad (7)$$

Where: K is the coefficient depended on the discharge

$$Q_{\min} = Q_{net} / \eta_{\min} = (q_{\min} * \omega) / \eta_{\min} \quad (8)$$

Where $$\eta_{\min} = \alpha^m / (1/\eta_{design} + \alpha^m - 1) \quad (9)$$

With

$$\alpha = q_{\min} / q_{design} \, (q_{\min} = 0.5 l/s/ha) \quad (10)$$

Roughness coefficient : can be obtained from TCVN 4118-85, appendix 9, table 3 n=0.017 for concrete canal

Side slope : According to the table 9.6 – "Irrigation System Planning and Design" based on natural condition, choose m = 1.25 for the soft clay soil.

The imperial- equation for stability canal

$$\beta = b/h = 3Q^{0.25} - m \quad (11)$$

Thus, get $\beta = 1.5$

From Manning's equation we can calculate b and h

$$Q = A * R^{2/3} * S^{1/2} / n \quad (12)$$

Where S is the longitudinal slope

R is the hydraulic radius

For the main canal

$$A = (b + m * h) * h \quad (13)$$

$$P = b + 2 * h * (1 + m^2)^{1/2} \quad (14)$$

For secondary canal m=0

Beside these , i also calculate the maximum velocity and minimum velocity for checking the permissible velocities in the canal.

Step 6: Calculate canal bed level

$$\nabla_{canalbed} = \nabla_{required} - H_{design} \quad (15)$$

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Step 7: Calculate canal bank level

$$\nabla_{canalbank} = \nabla_{canalbed} + H_{design} + \delta \quad (16)$$

$$\nabla'_{canalbank} = \nabla_{canalbed} + H_{\max} + \delta' \quad (17)$$

Where,

H_{design} is the design water depth in the canal

H_{max} is the maximum water depth in the canal

δ is the free board at H_{design}; According to Vietnamese standard with discharge smaller than 10 m^3/s, δ=0.2 m.

δ' is the free board at H_{max}. Its value is derived from table 10 in TCVN 4118-85. The design discharge is smaller than 1, so δ'= 0.1 – 0.15. We take δ'=0.15 for safer.

Choose the higher value of two calculated canal bank level.

Step 9: Check for controlling self-irrigation of the canal system.

$$\nabla_{\min} = \nabla_{canalbed} + H_{\min} \quad (18)$$

$\nabla_{\min}$ is compared with the requirement of controlling self-irrigation of the secondary canal system

Step 10: Calculate total volume and cost

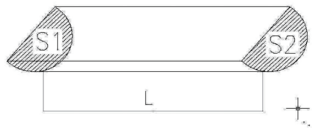

Fig . 2 Longitudinal section of a canal segment

To calculate excavation and fill volume

Volume of excavation and backfill for each channel segment can be calculated as follows

Average area of excavation volume:

$$S_{excavation} = (S_{first} + S_{last})/2 \quad (19)$$

Excavation volume:

$$V_{excavation} = S_{excavation} * L_{section} \quad (20)$$

The average area of fill volume :

$$S_{fill} = (S_{first} + S_{last})/2 \quad (21)$$

Fill volume:

$$V_{fill} = S_{fill} * L_{section} \quad (22)$$

Step 11: Determine position, appearance and basic dimensions of the structure on the canal.

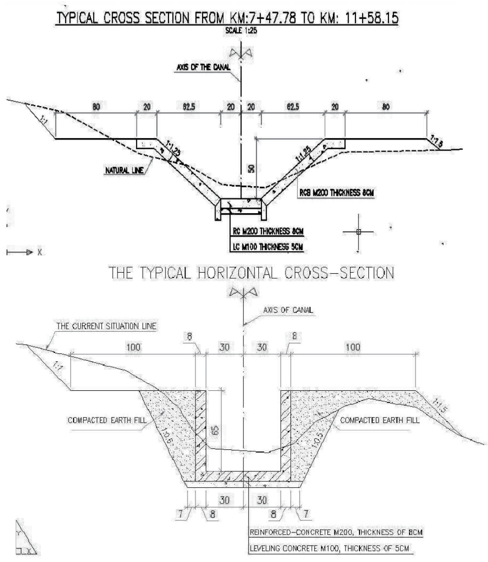

Fig . 3 Typical cross-section of main and secondary canal

Step 12: Construction time

Tan Son reservoir system is the major water supply structure for agricultural production of system, so the time of construction must be not affect to the production. Therefore, autumn-winter is the best time to start when the water requirement is not high, and low rainfall,

4. ENVIRONMENTAL IMPACTS

In general, this project which related to the development of water resources usually has a vital role. This can bring not only a huge advantage for the community but also leave the bad effect on the environment

(1) Possible impacts

After the project is completed, it will bring a lot of advantages for the benefit region , such as: Increase the production, productivity and agricultural output in the region because of increasing of cultivated land and water supply capacity, reduce the water loss, ensure water to use for people needed, reduce the maintaining cost., contribute the development of economic in region, increasing the income and improving the living of farmer

(2) Negative impacts

These bad effects are happened primary on the construction time such as : It raises the waste matter and waste water that will make the environment becoming polluted, because the construction requires many workers, air pollution, the air environment will also be polluted due to the operation of equipment and machinery in construction time, During the construction time, solid waste such as: mortar, gravel, sand, etc will be poured directly into cultivated region of two sides of canal system and it has influence on cultivation of farmers if these wastes are not collected and treated, there are some scatter materials in the road that may have effects on traffic during transportation process

(3) Mitigation measures

Using construction means that rare familiar with the environment. Transportation vehicles have to cover fully to reduce the scatter material in the road during the transferring process, collect and treat the solid waste immediately, using local manpower to decrease the concentration of labor from other places

It is clear that the project can bring a lot of advantages for the project region after the project is completed. Although there are still some disadvantages, we believe that these measures can contribute to reducing the negative impacts to the local environment of project

5. ECONOMIC EVALUATION

The main purpose of economic calculation is found out the economic indicators: net present value NPV, Internal rate of return (IRR %), the ratio of earnings to fixed charges (B/C), the ratio of net present value to initial cost (NPV/K), project sensitivity, to evaluate economic benefits of the project

Calculation the economic indicators of the project has great significance in evaluating the economic efficiency, to ensure that the government's investment to be highly effective. Besides, accurately calculation the economic indicators will be an important basis in asserting the costs and benefits of the project. Then, compare costs and benefits of selected with other options to find out the best options in term of economic

6. CONCLUSION S

Depend on the data of population, economic and society, we can see that : in the surveying region, agricultural is the main source that bring the profits for the almost citizen, the water source for agricultural is subsidiary to natural. There are lots of cultivated lands which do not enough water to irrigate. The irrigation capacity of hydraulic works is quite large, but their effectiveness is low and they just provide water for a small cultivated area. In recent years, the agriculture economic in the project area has brought many new rice varieties that have high productivity, high quality in manufacturing with the area that can be irrigated with enough water Therefore, to increase the agricultural economy, besides applying the scientific and technical progress about cultivation and fertilizer, ensure the water requirement to irrigate effects to economy of agricultural production. With the current status of the project area as described above showed that irrigation work did not meet the economic development needs in the region. Therefore, the investment to design and upgrade Tan Son reservoir system is necessary

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