E3S Web of Conferences **587**, 01005 (2024) https://doi.org/10.1051/e3sconf/202458701005
GreenEnergy 2024

Parametr of a parabola-shaped canal method of determinaton

Maqsud Otakhonov[1], *Dinislam* Atakulov[1], *Ilkhomjon* Zokirov[1*], and *Quvonch* Xudoyshukurov[2]

[1] National Research University "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers", 100000, Tashkent, Uzbekistan
[2] UzSuvloyiha MChJ, 100128, Tashkent, Uzbekistan

Abstract. This article presents a method for determining the parabolic parameter of a channel with a parabolic cross-section. Several sections of earthen canals were selected. The research was carried out in natural field conditions using a high-precision measuring device "Son tek S5". The data obtained as a result of the research were analyzed mathematically and statistically. Accordingly, it was determined that the parabola parameter changes from 31.43 to 43.40. field conditions are highlighted.

1 Introduction

Humanity has been engaged in irrigated agriculture since ancient times. We know that agricultural products are grown as a result of farming [1,2]. Irrigation in the field of agriculture and the production of agricultural products are influenced by several factors [3,4]. These include the quality of plant seeds, agrotechnology, irrigation technology, land reclamation, irrigation water quality, and others. Among the listed factors, the issue of irrigation water is of particular importance. Basically, water reaches the irrigated fields through canals. Therefore, the importance of canals in the cultivation of agricultural products in irrigated areas is incomparable [5,6].

People have been building canals since ancient times. Based on the current conditions of the period, they designed and built canals. Later, studies were conducted to determine the optimal parameters of the canals. As a result of the conducted research, recommendations for determining the hydraulic parameters of canals were developed [7,8,9]. In the developed recommendations, the issues of determining the parameters of the hydraulically most favorable section of the canals, assessing the turbidity carrying capacity of the stream are presented [10,11,12,22,23]. We know that water reaches the irrigated fields in our country through canals. The total length of canals of our republic is more than 180 thousand km, of which 85% is made of soil. In the design and construction of canals, for certain reasons, the section is based on the shape of a trapezoid. Over the years, the change of cross-section due

[*] Corresponding author: ilhomjonzokirov1@gmail.com

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

to deformation in canals with soil cores has been studied by researchers [13,14, 15,20,21,22,24].

It is known that in hydraulic calculations, there are 6 elements of a trapezoidal canal. These include water consumption, canal bed width, flow depth, canal side wall slope, canal slope, roughness coefficient [16,17,18]. In the studies, it is based on the fact that the section of the canal built in the form of a trapezoid is formed in the form of a parabola. Currently, a number of works are being carried out in connection with digitalization of water consumption calculation in canals, remote monitoring of online data [19]. When digitizing the calculation of water consumption, it is necessary to include an algorithm for calculating the cross section of the flow in the software. Therefore, in digitalization issues, it is very important to determine the importance of the parabolic parameter in canals with a parabolic cross-section.

But determining the parabolic parameter of a parabolic canal is one of the complex issues. Conducting research in natural field conditions, determining the parabolic parameter in canals with a parabolic cross-section is one of the important issues in the field of hydraulics and engineering hydrology.

2 Methods

In order to determine the parabolic parameter of the canal, research was carried out in the Northern Fergana canal. Generally accepted methods in the field of hydraulics and hydrology were used in conducting research. Water consumption, depth, movement section and other hydraulic elements in the canal were determined using a modern "Sontek S5" doppler. The identified data were analyzed in the methods of mathematics and statistics. The parabola-shaped section of the canal is defined as follows:

$$x^2 = 2py \tag{1}$$

Here: p-parabola parameter.

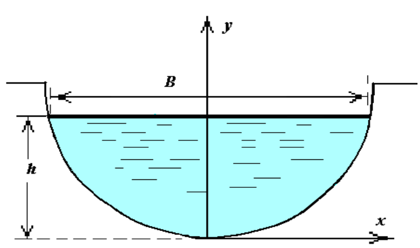

Fig. 1. Cross-section of a parabola-shaped canal

If we specify $x = \frac{B}{2}$, then the width of the water level of the canal (B) is written as follows:

$$B = 2\sqrt{2ph} \tag{2}$$

If we take the flow depth $h = y$, then the cross-sectional area in motion is determined as follows:

$$\omega = \frac{2}{3} hB \tag{3}$$

Using the above expressions (2) and (3), the parabola parameter (p) is determined as follows:

$$p = \frac{9\omega^2}{32h^3} \tag{4}$$

3 Results and discussion

Measurement works were carried out in the 4th section of the Northern Fergana Canal. Characteristic elements were selected in the measurement work. Hydraulic elements in the selected walls were determined. In the 1st section of the research object, it was determined that the water consumption Q=18.76 m3/s, the width of the canal at the water level B=14.45 m, the movement section ω=26.60 m2, the flow depth h=1.85 m (Figure 2).

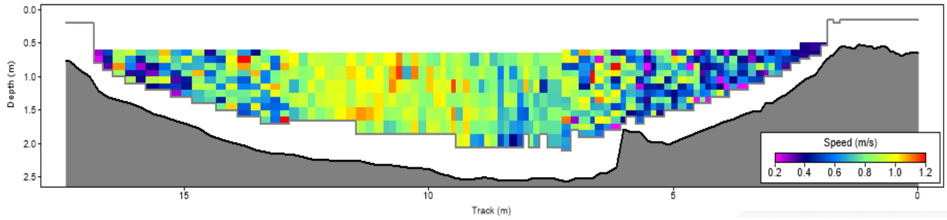

Fig. 2. Cross-section of the Northern Fergana Canal PK-410

In the 2nd section of the research object, it was determined that the water consumption Q=20.33 m3/s, the width of the canal at the water level B=16.30 m, the movement section ω=29.13 m2, the flow depth h=1.52 m (Figure 3).

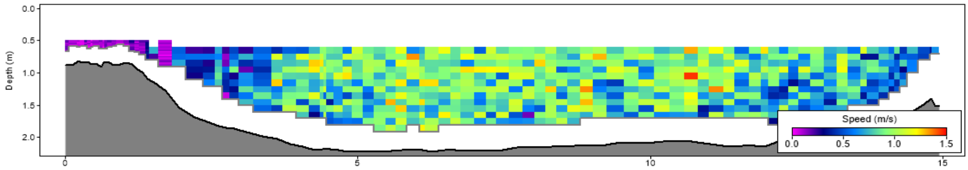

Fig. 3. Cross-section of the Northern Fergana Canal PK-430

In the 3rd section of the research object, it was found that the water consumption is Q=18.07 m3/s, the width of the canal at the water level is B=14.78 m, the movement section ω=26.63 m2, the flow depth h=1.55 m (Figure 4).

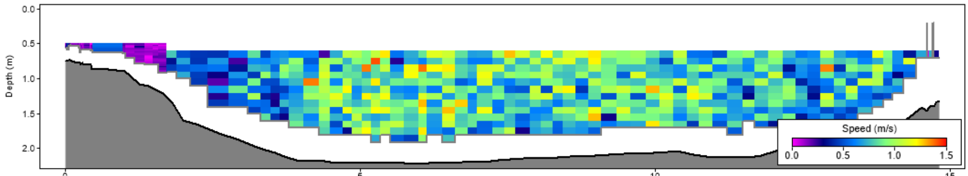

Fig. 4. Cross-section of the Northern Fergana Canal PK-440

In the 4th section of the research object, it was determined that the water consumption Q=40.41 m3/s, the width of the canal at the water level B=23.67 m, the movement section ω=48.02 m2, the flow depth h=2.51 m (Figure 5).

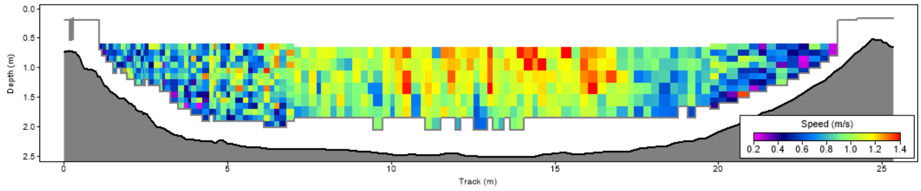

Fig. 5. Cross-section of the Northern Fergana Canal PK-450

In the 5th section of the research object, it was determined that the water consumption Q=41.65 m3/s, the width of the canal at the water level B=24.27 m, the movement section ω=48.81 m2, the flow depth h=2.49 m (Figure 6).

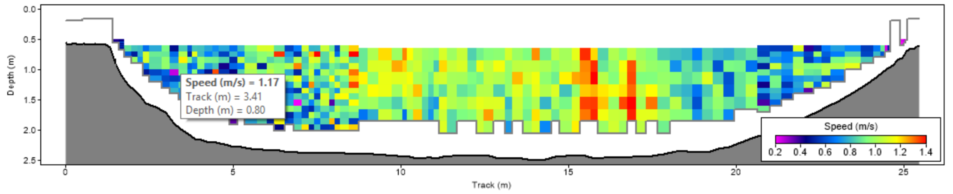

Fig. 6. Cross-section of the Northern Fergana Canal PK-460

In the 6th section of the research object, it was determined that the water consumption is Q=40.44 m3/s, the width of the canal at the water level is B=22.4 m, the movement section is ω=50.5 m2, and the flow depth is h=2.64 m (Figure 7).

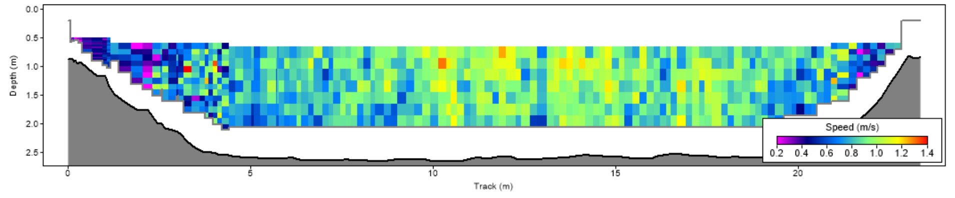

Fig. 7. Cross-section of the Northern Fergana Canal PK-470

In the 7th section of the research object, it was determined that the water consumption Q=39.84 m3/s, the width of the canal at the water level B=21.44 m, the movement section ω=49.17 m2, the flow depth h=2.63 m (Figure 8).

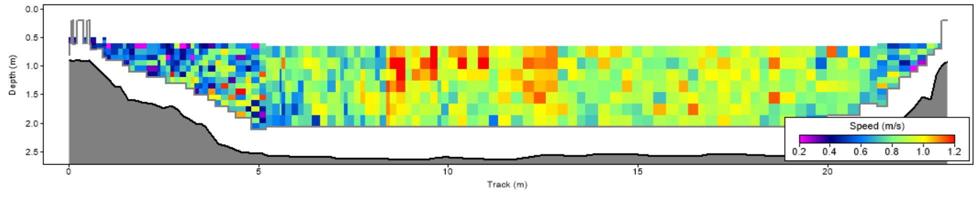

Fig. 8. Cross-section of the Northern Fergana Canal PK-480

In the 8th section of the research object, it was determined that the water consumption Q=39.78 m3/s, the width of the canal at the water level B=23.82 m, the movement section ω=48.36 m2, the flow depth h=2.49 m (Figure 9).

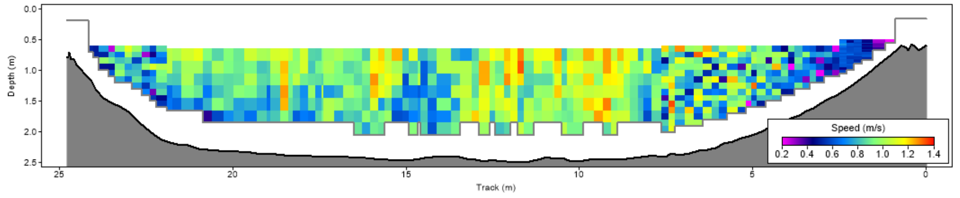

Fig. 9. Cross-section of the Northern Fergana Canal PK-500

The results obtained in natural field conditions were analyzed in mathematical and statistical methods. The following formula was used to determine the parabolic parameter of the canal:

$$p = \frac{9\omega^2}{32h^3} \tag{5}$$

As a result of the analysis, it was determined that the parabola parameter of the section of the 4th section of the Northern Fergana canal changes from 31.43 to 43.40. The results of the analysis are presented in the following table (Table 1).

Table 1. Table for determining the parabola parameter in the canal

Sections	ω, m^2	h, m	B, m	p, m	B/h
PK-410	26.6	1.85	14.45	31.43	7.81
PK-430	29.13	1.87	16.3	36.50	8.72
PK-440	26.63	1.75	14.78	37.22	8.45
PK-450	48.02	2.51	23.67	41.01	9.43
PK-460	48.81	2.49	24.27	43.40	9.75
PK-470	50.48	2.64	22.49	38.95	8.52
PK-480	49.17	2.63	21.44	37.38	8.15
PK500	48.36	2.49	23.82	42.61	9.57

These results were analyzed in the methods of mathematics and statistics, and the relation of the parabola parameter to the canal relative width B/h was obtained (Figure 10).

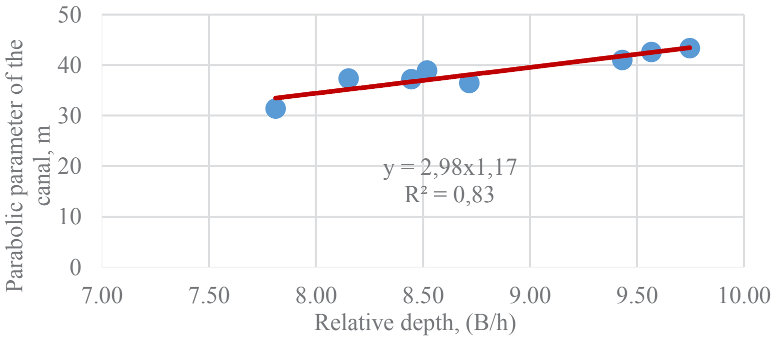

Fig. 10. Graph of relationship of canal parabola parameter with relative depth (B/h)

Based on the above connection, the following formula was developed:

$$p = 2{,}98\left(\frac{B}{h}\right)^{1{,}17} \tag{6}$$

Using the given formula (6), it is possible to determine the parabolic parameter of a parabolic canal. Especially in canals, the use of programs for calculating the movement section has a positive effect on the digitalization of the water flow calculation.

4 Conclusion

As a result of the research carried out in natural field conditions, it was found that the cross-section of the movement in the 4th section of the Northern Fergana canal is in the form of a parabola. In this section of the canal, it was found that the parabola parameter value changes from 31.43 to 43.40. The results of the research were analyzed in the methods of mathematics and statistics, and the relationship between the parabola parameter and the relative width of the canal B/h was obtained. As a result of the conducted research, it was established that the parabolic parameter of the canal depends on the relative width (B/h). It is advisable to use this formula to determine and digitize the traffic section in the canals.

References

1. Han X, Wang X, Zhu Y, Huang J, Yang L, Chang Z and Fu F 2020 Water (Switzerland) **12(9)** https://doi.org/10.3390/W12092343
2. Abdulrahman A 2007 Journal of Hydraulic Engineering **133** 695-697
3. Arifjanov A, Fatxulloyev A and Samiyev L 2015 Irrigation and Melioration, pp 40-43
4. Samiyev L, Allayorov D, Atakulov D and Babajanov F, 2020 IOP Conference Series: Materials Science and Engineering, **883**(1), doi: 10.1088/1757- 899X/883/1/012031
5. Kaletova T, Arifjanov A, Samiev L and Babajanov F 2022 Journal of Water and Land Development, pp 21-26
6. Schleiss A J, Franca M J, Juez C and De Cesare G 2016 Journal of Hydraulic Research, **54(6),** pp 595-614
7. Samiev L, Vokhidova U, Tursunova E, Apakhodjaeva T, Babajanov F and Shaymardonov S 2024 E3S Web of Conferences **508**, 07006
8. Kovalenko P and Mikhaylov Yu 2008 Journal of Water and Land Development **12** 244-251
9. Samiev L, Shaymardanov S, Xoshimov S and Mamadiyorov O 2023 E3S Web of Conferences **452**, 02019
10. Sherov A, and Irismatova A 2018 Journal Sustainable Agriculture. Tashkent**. 1**
11. Jurík Ľ, Zeleňáková M, Kaletová T, Arifjanov A 2019 The handbook of environmental Chemistry. **69,** pp115-131
12. Fatxulloyev A, Gafarova A and Hamroqulov J 2021 IOP Conference Series **1030(1)** 012145
13. Abduraimova D, Rakhmonov R, Akhmedov I, Xoshimov S and Eshmatova B 2022 Paper resented at the AIP Conference Proceedings **2432,** doi:10.1063/5.0089645
14. Latipov N, Abduraimova D, Ibragimova Z, Otakhonov M, Hamdamov M 2023 E3S Web of Conferences **401**, 03072
15. Entrainment of E. coli and Listeria monocytogenes from sediment in irrigation canal. International Journal of Sediment Research vol. **37(6),** pp.701-714 (2022)
16. Rikhsikhodzhaeva G, Rizaev A N, SmanovB, Ubaidullaev B, Khamidov B, and Guro V 2020 International Journal of Scientific and Technology Research, **9(2),** 922-925.
17. Rakhimov K, Otakhonov M, Melikuziyev S and Sultonov R 2024 BIO Web of Conferences Vol. **105**, 05016
18. Arifjanov A, Atakulov D, Usmonova M and Voxidova U 2023 XV International Online Conference "Improving Farming Productivity and Agroecology – Ecosystem Restoration"
19. Arifjanov A, Vokhidova U, Tursunova E and Melikuziyev S 2024 E3S Web of Conferences **508**, 07005
20. Samiyev, L., Allayorov, D., Atakulov, D., Babajanov, F. (2020) IOP Conference Series: Materials Science and Engineering, **883(1),** art. no. 012031. https://iopscience.iop.org/journal/1757-899X. doi: 10.1088/1757-899X/883/1/012031
21. Arifjanov, A., Samiyev, L., Babajanov, F., Tadjiboyev, S., Akramov, J., E3S Web of Conferences, 2024, **538,** 03010
22. Alikhanov, B., Pulatov, B., Samiev, L. Vegetation Cover Change in Ugam Chatkal National Park, Forum Geografi, 2024, **38(1),** pp 11–27.

23. Arifjanov, A., Samiev, L.N., Kaletová, T. Acta Hydrologica Slovaca, 2021, **22(2),** pp. 313–319
24. Arifjanov, A., Kaletova, T., Abduraimova, D., Samiev, L., Jalilova, X. IOP Conference Series: Earth and Environmental Science, 2022, **1112(1),** 012131