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Study of the process of deformation in the area of confluence of streams

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ABSTRACT: In the article, based on the comparison method, the problems of the deformation process occurring in the joining zone of excavation channels and erosion caused by its impact during the operation of the channels are investigated. The dependence of hydraulic parameters in the confluence zone of two streams on flow speed is shown.

KEY WORDS: flow, bedrock, liquid, junction angle, channel, area, bedrock deformation.

I.INTRODUCTION

If we study the irrigated area of Kashkadarya region, about 80% of the irrigated land area receives water from the Amudarya river, which flows through the neighboring country of Turkmenistan, through unique pumping stations under the Karshi main channel. As we know, the water content of the Amudarya River ranks first in the world in terms of turbidity. The composition of the turbidity leads to the premature failure of the channels in the irrigation system. This system consists mainly of earthen channels. During the distribution of water from such channels to consumer channels, as well as in the accumulation zones formed during the joining of two channels, mud and sand particles intensively sink and change the shape of the channel. This, in turn, causes excessive costs in hydrotechnical structures.Based on this situation, scientific determination of the shape of the deformable core channels, which does not form the formation zone, is considered one of the urgent problems today. In other words, scientifically recommending the form of channel beds that carry water continuously without the required water consumption is considered the main requirement in the design and operation of earthen channel channels. The place where two currents meet at an angle is called the confluence zone.Flow junctions are a complex hydrodynamic process.That is, big changes in flow dynamics occur in this zone. Processes such as deformation of many blurs occur here.

In order to study the deformation process in the confluence zone of two streams, first of all, we need to consider where this process takes place and how to study it.We can see this process being designed and used in PK 935+00 section of MMC (Mirishkor Main Channel) located in Mirishkor District, Kashkadarya Region.The part of the Mirishkor channel under investigation is an excavated, earthen channel, so the processes in its bed have been deformed.The joining of channels forms a single stream. [1] The issue of confluent flows has been studied by various authors.For example, in [2], the processes at the confluence of rivers and streams were studied in kind.In [3], adding a plate in the middle of the channel and circulating currents was considered using numerical methods. Best J.L [5]

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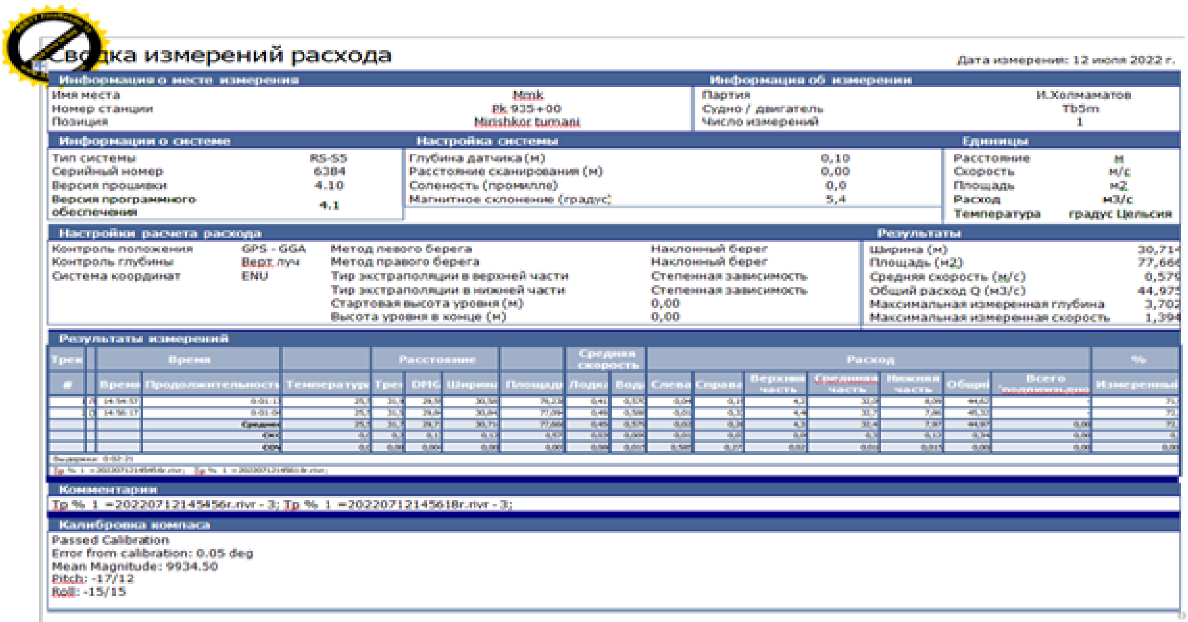
picture 1.
MMC (Mirishkor main channel) located in Mirishkor district of Kashkadarya region.

II. METHOD

Deformations in the channel are studied in turn into reversible and irreversible deformations.When we compared the current state of the Mirishkor channel project, we found out that it has undergone irreversible deformation.We accepted this research area as a place to study problems.We study the problems of the work and offer our recommendations to him.The initial operational indicators of this channel were as follows:In PK 935+00, the width of the channel is B=35 meters, water consumption Q=49 (m^3/s), cross-sectional area ω=70.2 m^2, maximum depth h_{max}=3 meters, average speed v=0.45 m/s, and the maximum speed was v=1.2 m/s.We obtained the following information based on our observational research.According to it, channel width B=30.71 meter, water consumption Q=44.97 m2, maximum depth h=3.7 meters, average speed v=0.5 m/s, and the maximum speed v=1.39 m/s was determined using River Surveyor's acoustic doppler.



Сводка измерений расхода

Дата измерения: 12 июля 2022 г.

Информация о месте измерения

Имя места	Mmk
Номер станции	Pk 935+00
Позиция	Mirishkor tumani

Информация об измерении

Партия	И.Холмаматов
Судно / двигатель	Tb5m
Число измерений	1

Информации о системе

Тип системы	RS-S5
Серийный номер	6384
Версия прошивки	4.10
Версия программного обеспечения	4.1

Настройка системы

Глубина датчика (м)	0,10
Расстояние сканирования (м)	0,00
Соленость (промилле)	0,0
Магнитное склонение (градус)	5,4

Единицы

Расстояние	м
Скорость	м/с
Площадь	м2
Расход	м3/с
Температура	градус Цельсия

Настройки расчета расхода

Контроль положения	GPS - GGA
Контроль глубины	Верт луч
Система координат	ENU
Метод левого берега	Наклонный берег
Метод правого берега	Наклонный берег
Тир экстраполяции в верхней части	Степенная зависимость
Тир экстраполяции в нижней части	Степенная зависимость
Стартовая высота уровня (м)	0,00
Высота уровня в конце (м)	0,00

Результаты

Ширина (м)	30,714
Площадь (м2)	77,666
Средняя скорость (м/с)	0,579
Общий расход Q (м3/с)	44,975
Максимальная измеренная глубина	3,702
Максимальная измеренная скорость	1,394

Результаты измерений

Трек #		Время: Время	Время: Продолжительность	Температура	Расстояние: Трек	Расстояние: DMG	Расстояние: Ширина	Площадь	Средняя скорость: Лодка	Средняя скорость: Вода	Расход: Слева	Расход: Справа	Расход: Верхняя часть	Расход: Средняя часть	Расход: Нижняя часть	Расход: Общий	Расход: Всего подвижн.дно	%: Измеренный
1	[illegible]	14:54:57	0:01:11	25,5	31,4	28,5	30,58	78,23	0,41	0,57	0,04	0,1	4,2	32,8	8,09	44,62	-	71
2	[illegible]	14:56:17	0:01:04	25,5	31,5	29,8	30,84	77,09	0,46	0,58	0,01	0,3	4,4	32,7	7,86	45,32	-	72
			Среднее	25,5	31,7	29,7	30,71	77,66	0,45	0,57	0,03	0,3	4,3	32,4	7,97	44,97	0,00	72
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0,00	[illegible]
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0,00	[illegible]

Комментарии

Tp % 1 =20220712145456r.rivr - 3; Tp % 1 =20220712145618r.rivr - 3;

Калибровка компаса

Passed Calibration
Error from calibration: 0.05 deg
Mean Magnitude: 9934.50
Pitch: -17/12
Roll: -15/15

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picture 2. STONEX R2 PLUS tachometer.

picture 3. River Surveyor flow speed acoustic doppler profilograph.

III.DISCUSSION

Based on Doppler data, the deformation process in the confluence zone of two streams was modeled in the Hydraulic Process Modeling Laboratory of the "Hydraulics and Hydrostructures" Department of the Karshi engineering economicsinstitute.

picture 4. Experimental research plot in the laboratory of modeling of hydraulic processes.

According to it, the geometrical and mathematical similarity of the channel was compared on the scale of M=1:100. The results of the experimental studies showed that the deformation process was observed in the diverted parts of the flow in the channel, that is, in the bends and junctions of the channel.In the deformed channel, the main reasons for the washing of the bottom and side parts of the channel were determined. Also, the mass of the flow moving along the cross section of the channel is moving along the area of the bend and junction of the channel. We know that during the flow of a liquid, the flow process is colloidal in the part of the direction of rotation, and in the part parallel to it, the flow process is impactful.This, in turn, leads to more than usual friction of the liquid during the kneading process.

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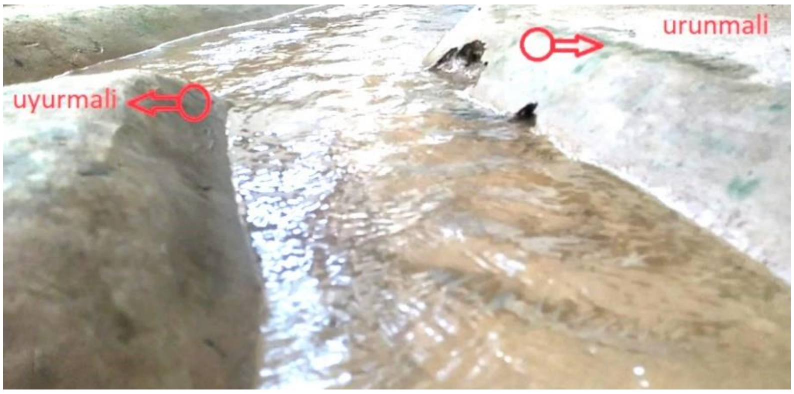

picture 5. It is a laborious and laborious process in the field of joining the channel.

When we studied the deformations in these processes, we determined the tendency of soil channels without fossil lining to be washed away and the origin of the state of deformation in these two processes. At a normal cross-section and a normal slope, the flow is laminar, and the flow rate reflects the following expression.

$$Q = \omega \cdot c\sqrt{R \cdot i} \quad \text{m}^3\text{/s} \qquad (1)$$

$$\vartheta = c\sqrt{R \cdot i} \quad \text{m/s} \qquad (2)$$

Here ϑ -flow speed, ω -the live cross-sectional surface of the channel, i -the hydraulic slope in the plane flow of the stream, *R*-hydraulic radius, *c*–Shezi's coefficient.

The live cross-sectional area and wetted perimeter of channels are determined from the following formulas:

$$\omega = b(b + mh)h \quad \text{m}^2, \qquad (3)$$

$$\chi = b + 2h\sqrt{1 + m^2} \quad \text{m}, \qquad (4)$$

here *b*- channel bottom width, *h*- water depth in the channel, *m*-coefficient of channel side slopes.

Hydraulic radius of surface

$$R = \frac{\omega}{\chi} = \frac{b(b + mh)h}{b + 2h\sqrt{1 + m^2}} \quad \text{m}, \qquad (5)$$

Shezi's coefficient is determined according to N.N. Pavlovsky's formula.

$$C = \frac{1}{n} R^y \qquad (6)$$

$$\text{if } R < 1m \; y \cong 1{,}5\sqrt{n}$$

$$\text{if } R > 1m \; y \cong 1{,}3\sqrt{n} \qquad (7)$$

here *n*- coefficient of roughness, y –degree indicator.

The value of the roughness coefficient n in the channels in the ground basins with normal operation is taken depending on the water consumption.

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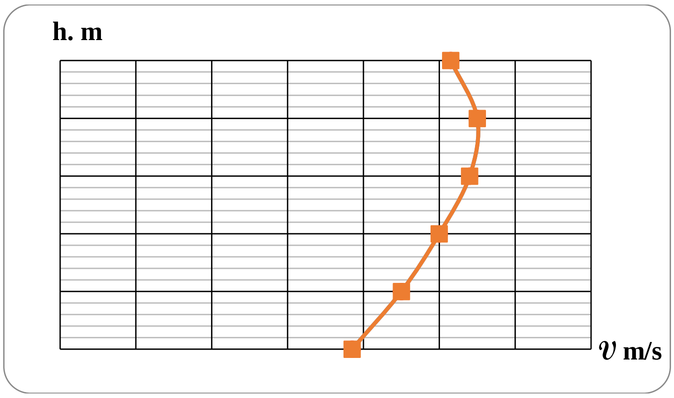
Q, m^3/s	< 1,0	1,0….25,0	> 25
n	0,03….0,025	0,025…0,0225	0,0225….0,020

5-5 The part where the two channels are joined, point 1 on the left
Smooth motion

№	b m	m	hk sm	Q l/s	V m/s	B sm	h mm	Z sm	V m/s	Vo‘r m/s
1-Tajriba										
1	0,27	1,5	4,8	0,019	1,5	43	1,0	24,64	1,23	1,222
							0,8	25,6	1,3	
							0,6	26,56	1,28	
							0,4	27,52	1,2	
							0,2	28,48	1,1	



5-5 The part where the two channels are joined, point 2 on the left
Smooth motion

№	b m	m	hk	Q l/s	V m/s	B sm	h mm	Z sm	V m/s	Vo‘r m/s
1-Tajriba										
2	0,27	1,5	4,8	0,019	1,5	43	1,0	24,64	1,24	1,252
							0,8	25,6	1,3	
							0,6	26,56	1,29	
							0,4	27,52	1,25	
							0,2	28,48	1,18	

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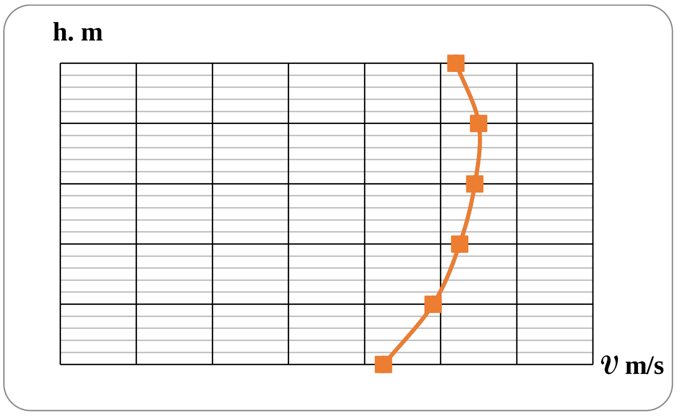
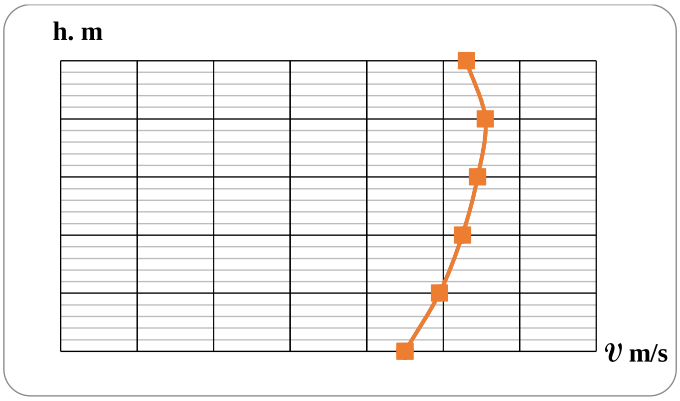


5-5 The part where the two channels are joined, point 3 on the left
Smooth motion

№	b m	m	hk	Q l/s	V m/s	B sm	h mm	Z sm	V m/s	Vo‘r m/s
1-Tajriba										
3	0,27	1,5	4,8	0,019	1,5	43	1,0	24,64	1,26	1,26
							0,8	25,6	1,31	
							0,6	26,56	1,29	
							0,4	27,52	1,25	
							0,2	28,48	1,19	



IV.RESULTS

It depends on the slope of the channel bottom and the level of the water receiving structure, the end point of the channel and the length of its route. Usually, the slope of the bottom of self-flowing channels varies between 0.0008...0.0005.

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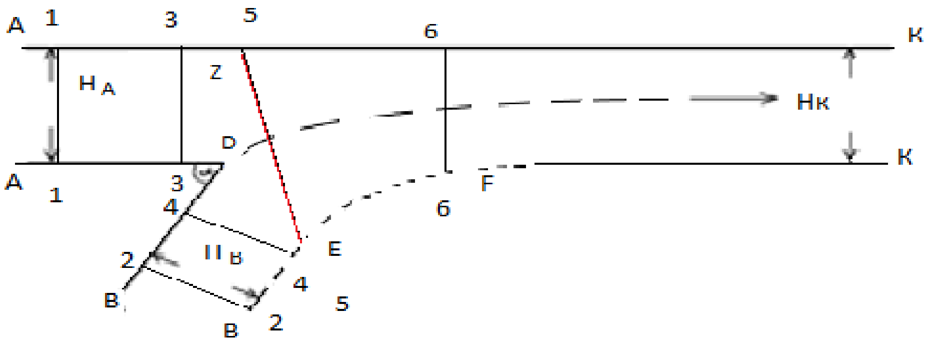

picture 6.

The MMC (Mirishkor Main Channel) that we are studying fully corresponds to the above parameters, and we consider the following function using the Jukovsky's method [1].

$$\omega = \ln \frac{V_o dz}{d\omega} = \ln \frac{V_0}{\vartheta} + i\theta \qquad (8)$$

here ϑ -modulus of fluid speed, θ -the angle of the speed vector with the X axis.

In picture 6, as $\vartheta = V_o$ along EF is $\ln \frac{V_o}{\vartheta} = 0$, the angle θ changes from O to α. KAD along $\theta = 0$ to this point θ the function changes to α .So, along DAE is $\theta = \alpha$. Taking into account the above, we draw the field of variation of the function $\omega(z)$ (picture 2).

We use the Christoffel-Schwarz formula for reflecting the resulting DEFD triangle (picture 2) on the $U = \xi + i\zeta$ half-plane [ ].

$$\omega = C_1 (U - U_1)^{\frac{\alpha_1}{\pi} - 1} (U - U_2)^{\frac{\alpha_2}{\pi} - 1} \dots (U - U_n)^{\frac{\alpha_n}{\pi} - 1} du + C_2 \qquad (9)$$

here $\alpha_1, \alpha_2, \dots \alpha_n$ are the interior angles of the polygon. C_1 and C_2 are complex invariants.In our case, the internal angles of the triangle DEFD are equal to $O, \frac{\pi}{2}, \frac{\pi}{2}$, respectively.

V.CONCLUSION

Confluence zones of two currents lead to washing and deformation of the banks of the channel or river. The formulas represent the shape of the EF curve section of one of the joining channels. (picture 1) This curve ensures smooth flow and the velocity changes very little along this line.This is a "Free surface" in our scheme. Reflecting the triangle in a half-plane prevents the deformation of the banks of the river bed in the confluence zones of the two streams and ensures smooth movement of the stream along this line.

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