INTERNATIONAL JOURNAL ON ORANGE TECHNOLOGIES
www.journalsresearchparks.org/index.php/IJOT e-ISSN: 2615-8140|p-ISSN: 2615-7071
Volume: 02 Issue: 10 | OCT 2020

Calculation of parameters of hydrodynamically stable earth ducts

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Abstract: The article describes the calculation of the parameters of soil-channel channels with hydrodynamic stability. It provides formulas to calculate the width and depth of water in large channels with hydrodynamically strong earth channels using existing studies.

Key words: stable channel, hydrodynamic stability, relative width, transport capacity. planned sustainability.

Introduction

At present, when calculating the sizes of stable channels, two main approaches are used: analysis of the morphometry of channels based on the theory of the regime and a physical approach based on the study of physical processes occurring in channels with deformable banks and bottom. The physical approach includes three main methods for calculating channels: the method of limiting pulling force, the method of permissible velocities and the method for determining the morphometry of stable channels based on the theory of hydrodynamic stability. The latter method, in a number of cases, made it possible to correctly describe complex physical processes occurring in channels with a movable bed.

The existing empirical dependences, which almost all in their form represent power relationships between the width, average depth, bottom slope, water discharge and sediment diameter, differ in different coefficients and exponents.

There are a large number of operating dependences, confirmed by a large number of experimental data, the main ones of which are the following:

1) Simons, Albertson [12]: $$L_m = \frac{h_{cp}}{\sqrt{2}} \frac{CM}{\sqrt{g}} \left(1 - K\frac{M}{C}\right)^{1/2},$$

(3)

where *M* – Boussinesq parameter (*M* $=22+24\, M^{0,5/c}$);

K – parameter of the logarithmic velocity distribution function;

hcp – average flow depth;

C – Shezy coefficient, assuming $L_M=8B$, B.C. Altunin [1] proposed a calculated dependence:

$$\frac{C}{\sqrt{g}} = \sqrt{0{,}2\left(\frac{B}{h_{cp}}\right)^2 + 43},$$

(4)

which for a given B / hav allows to calculate C and, conversely, with a known C makes it possible to determine the relative width B / hav.

In [5, 6], as a result of solving the problem of hydrodynamic stability of the channel, taking into account its transporting ability, an expression was obtained for the initial length of the meanders, which, assuming the conditions of the clarified flow, takes the form:

$$L_м = \frac{\pi C^2 h_{cp}}{g} \qquad (5)$$

Accepting $L_M=30$ As a characteristic scale at which the condition of flow quasi-stability is maintained, we have obtained a dependence for calculating the relative width of stable earth channels in sandy unbound soils in the form:

$$\frac{B}{h_{cp}} = 0{,}1\frac{C^2}{g} \qquad (6)$$

Later, as a result of analyzing the existing regime dependences using the dimensional method, we obtained dependences for calculating the width and average depth of a dynamically stable channel, which are in fairly good agreement with empirical data (Figs. 1, 2):

$B=7{,}76\, d_{cp} Q^{`0{,}440}$ при $Q^{`} \geq 10^{11}$;

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$B=0{,}0023\, d_{cp}Q^{`0{,}760}$ при $10^{10} \le Q` < 10^{11}$; (7)

$B=0{,}30\, d_{cp}Q^{`0{,}550}$ при $10^{9} \le Q` < 10^{10}$;

$B=88\, d_{cp}Q^{`0{,}275}$ при $Q` < 10^{9}$;

$h_{cp}=0{,}04\, d_{cp}Q^{`0{,}503}$ при $Q` > 10^{11}$;

$h_{cp}=10{,}4\, d_{cp}Q^{`0{,}281}$ при $10^{9} \le Q` \le 10^{11}$; (8)

$h_{cp}=0{,}19\, d_{cp}Q^{`0{,}475}$ при $Q` < 10^{9}$;

где
$$Q` = \frac{Q}{d_{cp}^{2}\sqrt{g d_{cp}(S-1)}}$$

The choice of the calculation formula for the channel width is carried out on the basis of comparing the calculated, laboratory and field data. Dependences (1), (2), (4), (6) - (8) were tested as formulas. The results of comparison of actual and calculated data are presented in Table 1. The analysis shows that dependences (7) and (6) give the best agreement with the actual data, and (7) gives more reliable values. This made it possible to recommend it as a calculated dependence for determining the channel width over the free surface.

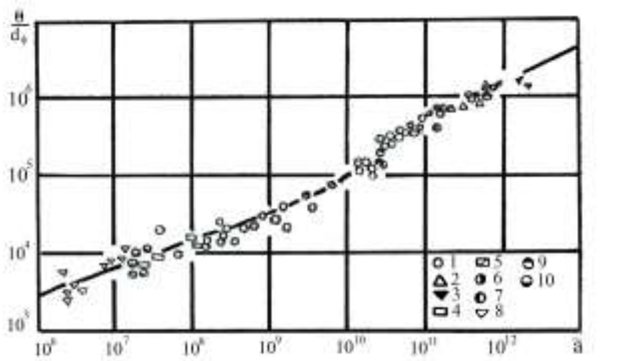

Figure: 1. Comparison of the measured and calculated by (7) values of the relative channel width:
1-Indo-Pakistani canals; 2-Karakum canal; 3-Volga-Caspian Canal; 8.10-laboratory data; 5-Amu-Daria; 6-Tash-Saka; 7-Kyz-Ketken; 9-rivers of Belarus.

Измеренные данные							Расчётные значения ширины русла (по свободной поверхности)				
источники	B м	Q м³/с	Vср м/с	hср м	%	d мм	Симонс, Альбертсон	Читале	Алтунин В.С.	Михинов А.Е.	По (4.15)
Алтунин В.С. Каракумский и Волго-Каспийский каналы	166,0	471,0	0,72	3,90	0,040	0,16	137,6	10,4	150	132,3	+151
	131,1	471,8	0,745	,83	0,045	0,15	137,7	112,4	184,4	+125,8	152
	148,2	475,0	0,59	5,46	0,024	0,15	138,2	122,9	184,4	+148,0	153
	258	1950	1,24	6,10	0,040	0,17	+280,0	217,9	334,1	392,2	281
	300	2010	0,67	10,0	0,0132	0,17	284,2	272,3	390,0	347,1	+285
	251	1490	0,96	6,2	0,035	0,17	244,7	198,4	273,9	268,7	+250
	171	616	0,60	6,0	0,021	0,17	157,4	143,7	211,5	174,9	+169
	260	1470	0,6	8,7	0,017	0,17	243,1	227,1	306,7	253,6	248
Читале, реки и каналы США, Пакистана	120	270	1,364	1,65	4,300	2,05	+104,2	161,9	-	4,4	40
	570	4196	1,963	3,75	1,595	0,32	+410,7	203,3	40,0	30,0	369
	183	2295	2,306	5,43	2,170	4,77	303,7	+226,6	21,2	25,4	95
	282	378	1,540	0,87	0,780	0,11	123,2	52,4	34,5	30,9	+143
	1380	6750	0,815	6,00	0,0167	0,010	520,9	285,4	337,7	359,2	+644
Данные [7], Аму-Дарья	300	1300	0,87	5,00	0,048	0,20	+228,6	176,9	186,7	120,9	+231
	110	170	0,70	2,20	0,041	0,15	82,7	63,0	74,8	+121,9	97
Таш-Сака Кыз-Кеткен	60	150	0,85	3,00	0,082	0,15	77,6	+59,9	107,7	89,9	92
Количество «+» Примечание: знак «+» показывает наилучшее соответствие							3	2	0	4	7

To calculate the probable channel depth, dependence (8) is proposed. Comparison with the calculation results (Table 2) according to (8) shows that the correspondence is quite satisfactory for the task at hand.

Comparison of the values of the width of stable channels, calculated by the formulas of various authors.

Comparison of measured and calculated mean channel depths.

Измерительные данные					Расчётная средняя глубина в соответствии с (2,4.10)
Источник	п/п	Q м³/с	dср мм	hср м	hср м
Алтунин В.С., Каракумский и Волго-Каспийский каналы [8]	1	471,0	0,16	3,90	4,17
	2	471,8	0,15	4,83	4,24
	3	475,0	0,15	5,46	4,25
	4	1950	0,17	6,10	8,39
	5	2010	0,17	10,00	8,52
	6	1490	0,17	6,20	7,32
	7	616	0,17	6,00	4,70
	8	1470	0,17	8,70	7,28
Данные [7] Аму-Дарья	9	1300	0,20	5,00	6,56
	10	170	0,15	2,20	2,54
	11	150	0,15	3,00	2,38
Машкович К., Михинов А.Е., Мойжес Н.Л. [4], экспериментальные данные	12	0,038	0,14	0,123	0,110
	13	0,038	0,14	0,123	0,110
	14	0,090	0,14	0,150	0,165
	15	0,031	0,14	0,077	0,099
	16	0,026	0,14	0,104	0,91
Викулова, лоток [2]	17	0,0044	0,20	0,034	0,037

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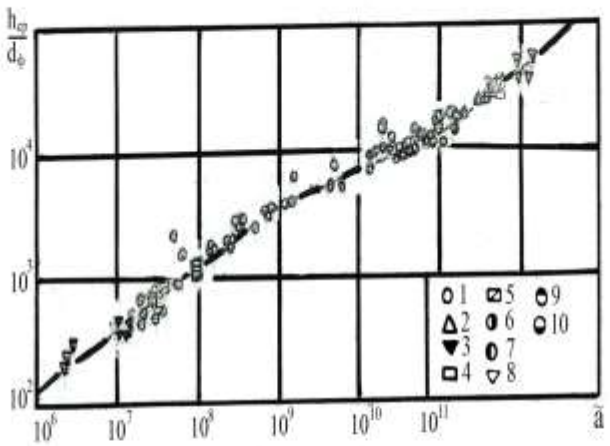

Figure: 2. Comparison of the measured and calculated by (8) values of the relative average depth of the channel (the legend is shown in Fig. 1)

Conclusions:

1. As a result of the analysis of existing dependencies using the dimensional method, dependencies were obtained for calculating the width and average depth of large earth channels.

2. The obtained dependencies can be used to design the parameters of the ground channels, i.e. to determine the width and depth of trapezoidal channels.

References.

1. Алтунин В.С., Ларионова Л.В. Гидравлический расчёт крупных каналов в легкоразмываемых грунтах. - Гидротехническое стро-во, №1, 1986, 26-31.

2. Викулова Л.И. Вопросы проектирования руслового режима каналов.-Тр.Гидропроекта, 1973, №30, 126-137.

3. Кереселидзе Н.Б. Теоретический критерий плановой устойчивости речных русел и каналов.-В кн.: Гидроэнергетическое строительство в горных условиях. Тбилиси, ГрузНИИЭГС, вып. 2.

4. Машкович К.И., Михинов А.Е., Мойжес Н.Л. Пространственно-временная изменчивость структуры донного рельефа экспериментального канала в условиях осветлённого потока.-Водные ресурсы, №6, 1985, 98-104.

5. Михинов О.Е, Определение элементов плановых и высотных деформаций больших земляных каналов по морфометрическим характеристикам. Автореферат дисс. на соиск. уч. степ. канд. технич. Наук, 1985.

6. Михинов А.Е. Плановая неустойчивость деформируемых русел. Метеорол. и гидрол., 1984, №6, 87-95.

7. Пачкуров А.Ф. Устойчивость русла регулированных рек-Минск: Изд-во АН БССР, 1950.

8. Рекомендации по гидравлическому расчёту крупных каналов (Совет по гидравлике при ГКНТ, 1986).

9. Chitale S.W. River channel patterns. Proc. ASCE, 96, HY 1, 1970.

10. Chilate S.V. Shape and sire of olluvial channels,-Proc, ASCE, July, 1976, 102 (HYS), 1003-1011.

11. Engelund F., Hansen E. A. monograph on Sediment Transport alluvial streams Teknisak Vorlag, Capenhagen. 1967.

12. Simons D.B., Alberlson M.L. Uniform water conveyance channels in alluvial material.-Proc, ASCE. May, 1969, 86 (HYS), 33.

13. S.S.Eshev, I.G'ayimnazarov, Sh.A.Latipov. On the calculation of the non-scouring velocities of a stationary water flow in channels lying in different soils. European science review, № 1-2, Vienna, 2019, p.145-148.

14. S.S.Eshev, G'ayimnazarov I, Sh.A.Latipov The Calculation of the Parameter of Friction in Border Layer Not Fixed Flow. International Journal of Advanced Research in Science, Engineering and Technology Vol. 6, Issue 1, January 2019, p.7796-7800.

15. Эшев С.С., Авлакулов М., Латипов Ш.А. Расчет параметров живого сечения устойчивых ирригационных каналов Научный мультитематический ресензируемый журнал (сетевое издание) «Научный исследования XXI века» №2(2) 2019 г. ISSN: 2713-1408 УДК 532(075.8) p.108-113.

16. S.S.Eshev, I.X.G'oyibnazarov, A.R.Rahimov, Sh.A.Latipov. Generation of Wind Waves in Large Streams. International Jounal of Psychosocial Rehabilitation, Vol. 24, Issue 01, 2020 p. 518-525.

17. S.S.Eshev, A.R.Rahimov, Sh.A. Latipov, F.F.Bobomurodov On the role of the influence of particle size distribution of bottom sediments on the conditions of the beginning of movement in watercourses. International Journal of Advanced Science and Technology Vol.29, No. 9s (2020), pp. 4049-4052 ISSN:2005-4238 IJAST Copyright © 2020 SERSC.