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Movement of High-Flood Waters in Channels in Conditions of Regulated a Water Flow.

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ABSTRACT: In article are given results studying of change movement of high-flood water waves in river channels in conditions of regulated a water flow by water reservoirs. Deciding the equation (indissolubility) of un-steady movement of water stream is received dependence for calculation of change of stream depth on length of regulated channels.

KEYWORDS: channel, flow depth, flow rate, water slope, water discharge, water level, coastal leaching, river bed.

Introduction. In conditions of regulated river flow of water by reservoirs, the channel in the downstream of the structure is also regulated by double-sided longitudinal dams to protect against flooding and erosion of the coastal strip of the river. During a flood, a large volume of water is urgently discharged from the reservoir. Under such conditions, a flood wave is possible in the river bed. (formula-1).

Materials and methods. When a flood is discharged, if the flow is saturated with sediments below the transporting capacity, then it erodes its channel, and if more, then the excess sediment is deposited by silting or skidding the channel. The movement of such a flow and the measurement of the wave parameter in the channel of the watercourse can be described by the equation (continuity) of the unsteady movement of water of the sediment-carrying flow in the form [3, 4]:

$$\frac{\partial H\cdot(1+S)}{\partial t}+\frac{\partial V\cdot H(1+S)}{\partial x}=S_*(V_*-V_{*0}) \qquad (1)$$

где S - weight turbidity of the flow;

S_* - turbidity of the blast;

V_* - the speed of the entrainment of the soil from the channel;

V_{*0} $=\sqrt{gH_o i}$ - hydraulic size of sediment;

V - flow rate;

H - flow depth;

i - water slope.

From (1) it follows

$$\frac{\partial H(1+S)}{\partial t}+V\frac{\partial H(1+S)}{\partial x}+H(1+S)\frac{\partial V}{\partial x}=S_*(V_*-V_{*0}) \qquad (2)$$

You can accept the hypothesis

$$H(1+S)\frac{\partial V}{\partial x} = S_*(V_* - V_{*0})$$

That is, involvement in

$$\frac{\partial V}{\partial x} > 0$$

and deposition

$$\frac{\partial V}{\partial x} \leq 0$$

$$(V_* < V_{*0})$$

Then

$$\frac{\partial H(1+S)}{\partial t} + V\frac{\partial H(1+S)}{\partial x} = 0 \qquad (3)$$

The flow velocity V can be approximately taken equal to

$$V = C\sqrt{Hi} + \sqrt{gH} = \left(\frac{C\sqrt{i}}{\sqrt{g}} + 1\right)\sqrt{gH} \qquad (4)$$

Lagrangian wave speed on the initial uniform flow.

C – Shezi coefficient.

Substituting (4) into (3) we obtain

$$\frac{\partial H(1+S)}{\partial t} + \beta\sqrt{gH}\,\frac{\partial H(1+S)}{\partial x} = 0 \qquad (5)$$

$$\beta = \left(\frac{C\sqrt{i}}{\sqrt{g}} + 1\right) = cons`t.$$

And the turbidity is determined by the formula

$$S = K\frac{V}{(gHw)^{\frac{1}{3}}}$$

Bringing equation (5) to a dimensionless form and applying the Laplace formation, we obtain:

$$[-H_{t=0}+(1+S)F(1+S)]+\frac{\beta\sqrt{gH}}{V_t}[-H_{x=0}+(1+S)F(1+S)]=0 \qquad (6)$$

$$\left[1+\frac{\beta\sqrt{gH}}{V_t}\right](1+\bar{S})F(1+\bar{S})=H_{x=0}+\frac{\beta\sqrt{gH}}{V_t}H_t \qquad (7)$$

where V_t - depth speed H_t;

Results. The transition to the true values of the equation (7) will be rewritten as:

$$H_{x,t}=F(1+S)=\frac{1}{\left(1+\frac{\beta\sqrt{gH}}{V_t}\right)}\left(H_t+\frac{\beta\sqrt{gH_o}}{V_t}H_x\right) \qquad (8)$$

or

$$H_{x,t}=\frac{1}{1+\sqrt{\frac{H_o}{H_t}}}\left(H_t+\sqrt{\frac{H_o}{H_t}}\cdot H_x\right) \qquad (9)$$

Equation (9) gives H as functions of x and t, flood wave height H_t–H_o =$H_в$ (formula 1)

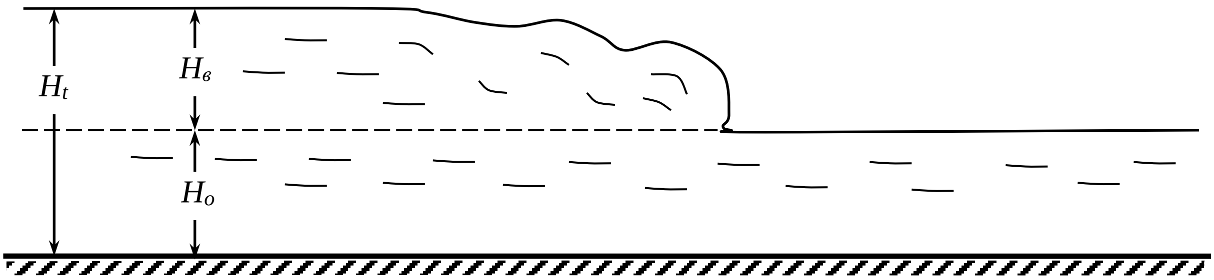

Figure 1. Calculated scheme of flood wave movement.

Discussion. Equation (9) was used to calculate the flow depth along the channel length. The original flow parameters were H_o =2,0 м, C =50 м^{0,5}/с, и i =0,00015. In 1 hour, the water level at the beginning was raised by 1.5 m, and the depth was H_t =3,5 м. In an hour, the stream moved 25 km. At the end of the section, the water depth according to the calculation turned out $H_{x,t}$ =2,9 м. The calculation showed a decrease in the height of the flood wave along the length. If at the beginning the height of the flood wave was $H_в$ =1,5 м, then after passing a certain time and distance, it decreased by 0.6 m, and became equal to 0.9 m.

Conclusions. Thus, the use of equation (8 or 9) makes it possible to calculate in advance the changes in the water level along the length of the channel and to establish the value of the safe discharge of water from the reservoir during a flood.

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