DOI: https://doi.org/10.5281/zenodo.11619767

HYDRAULIC MODELING OF THE CHANNEL FORMATION PROCESS

Madina Uzokova
Student, Uzbekistan Karshi Engineering and Economic Institute, Karshi, Uzbekistan
Emal: shakhboz2016@mail.ru

Abstract: *Based on the Ackers-White dependencies for determining sediment flow in stationary flows, a method for calculating sediment with an unsteady flow is proposed, taking into account the division of sediment into bottom and suspended, which relates to the calculation of sediment transport itself.*

Key words: *sediment, bottom and suspended sediment, unsteady flow, wave, dimensionless parameters, passing flow.*

Gravity and friction forces are the main forces in the smooth flow of water in canals.

The problem of physical modeling involves the development of a reduced scale of the phenomenon under study that provides a greater degree of similarity to what occurs in the model and in nature. In this case, the natural physical processes that occur in nature should also be observed in the model.

One of the main requirements in the study of the plane movement of liquids is to ensure the mechanical similarity of the studied kinematic-dynamic phenomena. Also, mechanical similarity determines the geometric similarity of the event that occurs, and the physical similarity of the environment in which the event occurs should be taken into account in order to ensure similarity.

In physical modeling, the processes studied in nature and in the model are represented by equations consisting of the same boundary conditions. Therefore, the dimensionless quantities in these equations must be the same in nature and in the model.

is only under the influence of the same gravitational force $F=mg$, then the similarity criterion $\frac{mgl}{m\vartheta^2}$or $\frac{mgl}{m\vartheta}$takes the form

Similar systems under the influence of gravity should have the same Froude number. From this condition the connection between speed and length scales $\alpha_\vartheta^2 = \alpha_\ell$will have an appearance. The system is affected by the internal friction forces of the liquid :F_j

$$F_j = \mu \frac{d\vartheta}{dn} \Omega,$$

where μ **is** the dynamic viscosity coefficient of the liquid; Ω **-** surface; n **-** perpendicular to the direction of speed.

Similarity matching parameter

$$\frac{F}{\mu\vartheta l} \text{or} \frac{l\vartheta}{\nu},$$

here $\nu = \frac{m}{\rho}$- and the scales $\alpha_\vartheta \cdot \alpha_\ell = \alpha_\nu$ are related to each other.

The similarity of the friction force is ensured by the equal Reynolds numbers in the model and in nature:

$$Re = \frac{\vartheta\ell}{\nu} = idem. \quad (1)$$

The similarity of the force of gravity is ensured by the equality of the Froude numbers in the model and in nature:

$$Fr = \frac{\vartheta^2}{g\ell} = idem. \quad (2)$$

When using the equation (2.1), the geometrical similarities between natures and models should also be applied to the geometry of the roughness parameter. In practice , this requirement may not be met for possible model sizes due to laboratory technical limitations. Moreover, for the case of turbulent flow, the essence of equation (1) is violated, because the frictional stresses associated with laminar and turbulent motion are considered as two components.

The process of modeling smooth motion in channels is based on the following three conditions:

$$\left.\begin{aligned} Fr &= idem; \\ C &= idem; \\ i &= idem. \end{aligned}\right\} \quad (3)$$

These provide modeling of both gravity forces (Froude number) and frictional forces (Reynolds number).

It is of great interest to evaluate the effect of time-averaged flow characteristics and turbulence characteristics of open flows on viscosity in solving practical problems using hydraulic modeling. Among them, the coefficient of hydraulic resistance (or the coefficient of hydraulic friction) ranks among the first. This is because, on the one hand, they are often considered the subject of research, and on the other hand, in some cases, they can participate as connecting parameters between flow characteristics and Reynolds numbers.

In the modeling of hydraulic phenomena under the influence of frictional resistance forces and gravity forces in the zone of square resistances, the following approach is taken:[1]

1. Taking into account the similarity of the geometric shapes, which ensures the equality of the relative shapes for the nature and the model, a model of the Uzan, which is similar in nature and the model, is built:[2]

$$\Delta_M/R_M = \Delta_H/R_H. \quad (4)$$

2. At the end of the section to be modeled, where there is a smooth flow, and at the boundary sections at the beginning of the model, where there is a non-uniform state, the kinematic movement of the fluid corresponding to nature takes place.

3. In the boundary section, additional conditions are created that ensure the equality of the Froude numbers for the model and the model.

It is possible to start conducting experimental studies (experiments) by fulfilling these conditions, which ensure the dynamic similarity of flow in nature and laboratory conditions.[3]

When choosing the geometric scale of the model, it is necessary to consider the following cases:

- the possibilities of the laboratory for conducting experiments;
- the requirement to ensure the similarity of height and width;
- if the mode of movement of the fluid in nature is turbulent, then it must be turbulent in the model;
- if in nature the turbulent motion is in the zone of square resistances, then in the model the turbulent motion should also be in the zone of square resistances.

in small-scale modeling leads to serious errors. As the turbulent flow increases, the effect of the viscous force decreases. If the Reynolds number

$$Re = \frac{\vartheta d}{\nu} > Re_{kr}. \quad (5)$$

if there is, it is possible not to take into account the forces of cohesion.

The process of modeling the water flow of deformable riverbeds is represented by the following parameters:[4]

$$\mathrm{A} = f\left(\rho, \mu, D, \rho_\rho, g, \ell, \vartheta_*\right), \quad (6)$$

where $\rho$and μ - the density and viscosity of the liquid; $D$and ρ_ρ- particle diameter and density; g - acceleration of free fall; ℓ - characteristic length; ϑ_*- dynamic speed.[5, 6]

If the onset of action is mainly in cases of suspended discharge, then$g$ can be replaced by the specific gravity of water:

$$\gamma_s = \left(\rho_\rho - \rho\right) g. \quad (7)$$

This allows us to create a dimensionless relation:

$$\Pi_\mathrm{A} = f\left(\frac{\vartheta_* D}{\partial}, \rho \frac{\vartheta_*^2}{\gamma_s D}, \frac{\rho_s}{\rho}, \frac{\ell}{D}\right). \quad (8)$$

The first two parameters indicate the Reynolds number and the Shields parameter for the particle.

of a unidirectional flow with a flat bottom $\vartheta_*$is defined as:

$$\vartheta_* = (gRS)^{1/2}, \quad (9)$$

where $R$is the hydraulic radius.

The following model scales can be derived from the dimensionless equations:

$$n_\nu = n_S = 1$$

$$n_{\vartheta_*} n_D = 1, \quad (10)$$

$$n_D \cdot n_{\gamma_s} = n_{\vartheta_*}^2 \quad (11)$$

$$n_{\rho_S} = n_\rho = 1$$

(12)

These equations ensure that the values obtained in nature and in the model fall at the same point of the Shields diagram, that is, the movement of fluids is set to take place in the model as it was in nature.[7]

If $\rho_s/\rho$the influence of If $\rho_s/\rho$the effect of is large, then the model does not fit.

REFERENCES:

[1] Латипов.Ш.А. Лабораторные исследования неразмывающих скоростей потока каналов в зернистых грунтах. «Eurasia Science» XXV Международная научно-практическая конференция 15 ноября 2019 Научно-издательский «Актуальность.РФ» Сборник статей часть I Colltcted Papers XXV International Scientific-Practical conference **<<Eurasia Science>>** PART I Research and Publishing Center <<Actualnots.RF>>, Moscow, Russia November, 15, 2019 Moscow 2019 p. 84-85.

[2] Мирцхулава Ц.Е. Надежность гидромелиоративных сооружений. М.: Колос, 1974. 280 с.

[3] Эшев С.С. Расчет деформируемых больших земляных каналов в условиях нестatsiонарности водного потока. Ташкент. ” Voris nashriyot”, 2018. -187с.

[4] Ackers P., Ehite W.R. Sediment transport new approach and analysis. Pros ASCE, Now. 1973, 99 (HY11-), p. 2041-2050.

[5] Engelund R., Hansen E. A. Monograph on sediment transport on Alluvial Streams. Techniques Vorlag Copenhagen, 1967.

[6] Meyer-Peter E. Miller R. Formulas for bed-load trans ort. –Ln. Proc. II Congr. IAHR, Stockhdm, 1948, vol 3, pl 39-64.

[7] Rakhimov, S. Ehsev, S. Latipov, и J. Rakhimov, «Positive and Negative Aspects of Digitalization of Higher Education in Uzbekistan», представлено на AIP Conference Proceedings, 2022. doi: 10.1063/5.0089690.