[003_11]Reports of Research Institute for Applied Mechanics

Brief Summaries of Papers Published in *Bulletin of Research Institute for Applied Mechanics (Japanese)* No. 4, March, 1954

On a Simple Description of the Laminar Wake Behind a Flat Plate

Hikoji YAMADA

As a continuation of the boundary layer treated by the Kármán-Pohlhausen method, the laminar wake of a flat plate placed edgewise to the stream of liquid is studied in a compact manner, i.e. the velocity distribution is assumed in a form

$$u/u_1 = a(\eta + \lambda e^{-\eta/\lambda}) + b\,\eta^3 + c\,\eta^4,$$

whose coefficients are determined as functions of x (the distance from the rear edge of the plate) by thesame conditions and equations as in the case of boundary layer. In this theory the introduction of the term $\eta + \lambda e^{-\eta/\lambda}$ is characteristic, assuring the zero-gradient on the wake centre line and the coincidence with the Kármán-Pohlhausen distribution of the boundary layer velocity at the rear edge of the plate, by the imposed condition

$$\lim_{x \to 0+} \lambda(x) = 0+.$$

The results are compared with the Goldstein's [Proc. Roy. Soc. London (A), 142 (1933), 545-562] with good accordance.

Method for the improvement of approximation of this theory is suggested.

On the Scouring Action of a Water Jet

RESEARCH COMMITTEE FOR HYDROLOGY

The scouring action of a water jet discharged into a sand layer under still water has been investigated experimentally. Two kinds of the scouring action have been found: the eruptional type and the flushing type. The former occurs as long as the hydro-static pressure applied to the nozzle is small, and when it exceeds a certain critical value which is a function of the ratio of the depth of the nozzle in the sand to its diameter, the sudden transition of the pattern from the former to the latter is observed. The greater part of the experiment, however, has been devoted to the study of the flushing because of its paractical importance.

The scouring action, characterised, for example, by the length of the cavity generated, increases in a logarithmic manner with the duration of the operation, but it may safely be said that the action is practically completed within the first a few multiples of ten minutes.

By analysing the results of the measurements by means of the dimensional consideration, a simple relation existing among the length of the cavity (l), the diameter of the nozzle (D), the velocity of the jet at the mouth of the nozzle (V) and the average diameter of the sand grains (d) has been found, namely

$$\frac{l}{D} = C\left(\frac{V}{\sqrt{s' g d}}\right)^{0.6},$$

where s' and g denote the relative density of the grains in the water and the acceleration due to gravity respectively, and C, the constant, depends upon the depth of the water.

This report was prepared by M. Kurihara and T. Tsubaki, the members of the committee.

Estimation of the Maximum Discharge of the Flood Experienced in the Chikugo River at the End of June, 1953 by the Traces of the Highest Water Level

Kinji SHINOHARA

This paper presents the results of the calculation of the maximum discharge by the traces of the highest water level of the big flood experienced in the Chikugo River, Kyushu, Japan, at the end of June 1953. Two methods of calculation are used in this paper.

(1) Using Manning's formula, the maximum discharge is calculated as follows.

$$Q = \sqrt{\frac{\sum(\Delta h_i)}{n^2 \sum\left(\frac{l_i}{A_m^2 R_m^{4/3}}\right) + \frac{1}{2g}\sum\left(\frac{1}{A_i^2} - \frac{1}{A_{i+1}^2}\right)}},$$

where

A_i, A_{i+1} = any two adjacent cross-sectional areas of the river,

$A_m = (A_i + A_{i+1})/2$

l_i = the distance of the two adjacent sections,

R = the hydraulic mean depth,

$\Delta h_i = Z_{i+1} - Z_i$

Z = the height of the traces of the highest water level.

(2) Assuming the values of n and Q, the water level of $(i+1)$-th section is calculated from the following formula:

$$Z_{i+1} = Z_i + \Delta h_i = Z_i + \frac{n^2 Q^2 l_i}{A_m^2 R_m^{4/3}} + \frac{Q^2}{2g}\left(\frac{1}{A_i^2} - \frac{1}{A_{i+1}^2}\right),$$

where Z_i is the known water level of the flood.

By varying the values of n and Q, and repeating this method, we can obtain the plausible values of n and Q such that the calculated water surface agrees fairly well with the traces of the highest water level of the flood.

From these methods, the maximum discharge is estimated to be 9500~10000 m^3/sec assuming $n = 0.038$.

On the Water-Level of a Tidal Lake (the Fourth Report)

RESEARCH COMMITTEE FOR HYDROLOGY

By the method of calculation presented in **6** of the first report, the influences due to an inner sea of infinite area upon the water-level of a tidal lake are examined. The following conclusions anticipated in the first report are proved valid:—The existence of an inner sea (a reservoir in other words) reduces the amplitude and the phase lag of the variation of the water-level of a tidal lake.