ERRATUM

PIVOT END-PLAY IN PRICE TYPE CURRENT METERS

by E. J. Speight, J. of Hydrol. (N.Z.) Vol. 3 (1), 1964

On page 29, the first line of the last paragraph should read: The effect of gradually increasing the clearance to 0.040 in. . . .

LETTERS TO THE EDITOR

Discussion of a Paper by A. J. Raudkivi

ESTIMATION OF ROUGHNESS COEFFICIENT FROM VELOCITY MEASUREMENTS IN OPEN CHANNELS

Ing. Jaroslav Martinec*

Experimental measurements in selected river reaches have been carried out in order to develop a velocity formula independent of individual judgment for the selection of the appropriate value of roughness coefficient. A brief summary of results is presented which may be of interest.

Discharge, longitudinal profile of the water level, cross sections and the mean diameter of the bed material (obtained by bed load sampling) were repeatedly measured at various water stages in representative reaches of rivers. Roughness coefficients according to various velocity formulas were calculated in order to find the most suitable formula for hydraulic computations of open channels.

Formulas using roughness coefficients according to tabulated classifications of channels, such as the Manning formula, were found to be unreliable due to difficulties in selecting the correct value of the coefficient. The validity of the Strickler formula using the mean diameter of bed material was found to be limited to higher values of the ratio R/k (R being the hydraulic diameter, k — mean diameter of the bed material), in accordance with the statement of Raudkivi (1963).

The following equation was derived (Martinec, 1958) for determining the coefficient C of the Chezy formula (in metres):

$$C = 17.7 \log \frac{R}{k} + 13.6 \quad \text{.......} \quad (1)$$

or, in feet,

$$C = 32 \log \frac{R}{k} + 24.6 \quad \text{.......} \quad (2)$$

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This is similar to the equation indicated by Raudkivi (in feet):

$$C = 32.6 \log \frac{y_o}{k} + 36.5 \quad \text{.......} \quad (3)$$

where the mean depth y_0 corresponds to the hydraulic diameter R. The additive constant 36.5 in Eq. (3) corresponds practically to the Nikuradse's constant A = 1.17 obtained for rough pipes (Nikuradse, 1933), whereas Zegzda (1938) obtained a value of A = 1.06 from experiments in flumes. A still lower value of A = 0.77 was obtained as an average from all our experimental measurements on rivers, corresponding to the additive constant of 24.6 in Eq. (2).

These results are plotted on a semi-logarithmic paper on Fig. 1 with Eqs (2) and (3) indicated for comparison.

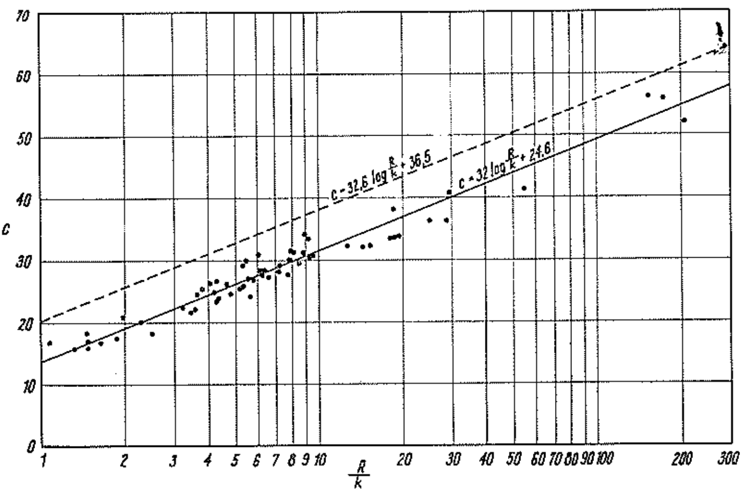

Fig. 1 — RELATION between the Chezy coefficient C and the relative roughness R/k.

Difficulties of comparing equations, with lengths in feet and metres respectively, may be eliminated by expressing Eq. (1) in a correct dimensional form:

$$C = 4 \sqrt{2g} \left(\log \frac{R}{k} + 0.77\right) \quad \text{.......} \quad (4)$$

where g is the acceleration of gravity.

It should be emphasised that the lower value of the additive constant obtained on natural streams, in comparison with higher values obtained for artificial conditions, was not caused by additional friction losses which are met on rivers very frequently due to channel irregularities. The Eq. (1) was derived only from measurements on river reaches as regular as could be found in order to eliminate all other factors than the bed roughness.

Further experimental measurements are in progress with the aim of evaluating the velocity losses due to irregularities of slope and cross sections, bends and ripple formation. Again a contribution to Raudkivi's results may be given: On a sandy-bed river with ripple formation the value of k = 2.5 mm was measured by bed-load sampling and k = 33 mm was calculated from Eq. (1) for the highest measured discharge.

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AUTHOR'S REPLY TO PRECEDING DISCUSSION

A. J. Raudkivi*

It is interesting that Mr Martinec's plot of the Chezy C against the relative roughness R/k for data obtained from measurements under a wide range of conditions agrees so closely with what was a derivation based on fixed plane bed of given uniform sand roughness. However, on changing from fixed to loose boundary the term k becomes indeterminate — the function relating k to particle size being unknown. Even in the simplest case of a straight narrow flume the effective k value changes many fold and a reduction in the C value is to be expected. This reduction need not be confined to the additive constant. When the effective k value changes then the value on the abscissa of the graph changes also. The author's flume experiments, with sand-roughened surfaces and Preston tube measurements of the bed shear, indicate a value in the region of 33 to 34 for the additive constant but not below 30.

When sediment transport takes place the bed will not be plane and the sand grain diameter will not suffice to explain the roughness. It is possible however, that empirical relationships — such as proposed by Martinec — could be established for certain regions of the flow. For example, from the author's Fig. 2, the

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f versus U relationship plotted on log-normal paper could be approximated to a straight line from the peak value of f to that at the transition flat bed, and an empirical relationship for this region may be of the form proposed by the writer. But even then some of the scatter in observed values would be due to variables not accounted for, such as slope, Froude number, Reynolds number, etc. An empirical relationship in terms of hydraulic mean radius R and the mean particle size would be very useful for the designer, particularly if the scatter is as small as shown on the writer's graph. But, it contributes little to the understanding of the mechanism of resistance in alluvial channels.

NEWS

FULLBRIGHT SCHOLARS

Three Fullbright research fellows are at present in New Zealand studying some aspect of hydrology.

Dr R. E. Dils, Professor of Watershed Management of Colorado State University, is attached to the Tussock Grassland and Mountain Lands Institute. He will study the problems of catchment management and natural drainage.

Professor D. B. Lawrence, of the University of Minnesota, is attached to Lincoln College and will study the advance and recession of glaciers in New Zealand.

Dr E. Deevey, Professor of Biology at Yale University, is attached to Canterbury University and will study how lake development has been affected by climatic changes.

FROM SOIL CONSERVATION AND RIVERS CONTROL COUNCIL

Staff Changes

Mr H. Drost, District Hydrologist, Whangarei, has been transferred to Hamilton to become the District Hydrologist of the Hamilton Hydrological Survey. In his previous position he supervised the Hamilton office for some three years. A transfer had