BED ROUGHNESS COEFFICIENTS FOR NATURAL CHANNELS IN MALAYSIA

BY:

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1. Letter of Report Submission

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Dear Sir,

FRGS FINAL REPORT "BED ROUGHNESS COEFFICIENTS FOR NATURAL CHANNELS IN MALAYSIA"

I refer to the matter above.

Please find enclosed herewith 2 (Two) copies of FRGS Final Report entitled "Roughness Coefficients for Natural Channels in Malaysia for your kind perusal. The softcopy of the report attach with a CD.

Thank you.

Sincerely,

Dr. Shanker Kumar Sinnakaudan
Head

Contents

5. Report

5.1 Proposed Executive Summary

Although much research has been done on Manning's roughness coefficient (bed roughness), n, for stream channels in overseas, very little has been done to derive the verified roughness values for streams in Malaysia. All hydraulic computations involving flow in open channels requires an evaluation of the roughness characteristics of the channel. At the present state of knowledge, the selection of roughness coefficients for natural channels remains chiefly an art and merely done by referring typical tabulated values according to factors that affect roughness listed elsewhere in the hydraulic text books (Chow 1959, Henderson, 1966, Barnes,1967 and Streeter, 1971 or Storm Water Management Manuals (DID 2000) without proper selection justification for Malaysian river condition. However, it is sometimes difficult to convince either the layman or the scientist that consistently reliable roughness coefficients need to be selected by trained engineers on the basis of sound judgment and experience. Furthermore, there are no resistance diagrams or quantitative relationships available similar to those used for steady flow in uniform pipes or for the frictional resistance of ships (Barnes, 1967). Consequently the ability to evaluate roughness coefficients for natural channels representing a wide range of conditions must be developed through experience. The experience necessary for the proper selection of roughness coefficients can be obtained in several ways, namely (1) to understand the factors that affect the value of the roughness coefficient in Malaysian river conditions, and thus acquire a basic knowledge of the problem, (2) to consult a table of typical roughness coefficients for channels of various types, and (3) to examine and become acquainted with the appearance of some typical channels whose roughness coefficients are known. Photographs of channels of known resistance are thus useful in estimating the roughness characteristics of similar channels. Familiarity with the geometry, appearance, and roughness characteristics of these channels will improve the engineer's ability to select roughness coefficients for other channels. To the untrained beginner, the selection of a roughness coefficient can be no more than a guess; and different individuals obtain different results. Thus, there is an urgent need to come out with such a reference material for Malaysian rivers by compiling photographs and bed roughness coefficient data which covers a wide river range conditions in Malaysia.

5.2 Enhanced Executive Summary

The selection of a base bed roughness coeffiecients for natural streams has been studied and the result of the verified bed roughness coefficient for the selected rivers was presented in this research. Field sampling has been done at 40 rivers having different ranges of slope, bed materials and morphology. Sampling activities and methodoligies adopted varied according to the type of reach and its typical bed material. The collected data were tabulated for typical river hydraulic properties namely Discharge ($Q_{measured}$), Velocity ($V_{measured}$), Width (B), Depth (Y_o), Area (A), Wetted perimeter (P) and Water surface slope (S_o). From the collected and well-processed hydraulic and sediment database, verification of the bed roughness by evaluating the existing bed roughness equation were defined as acceptable by implying the discrepancy ratio of 0.5-2.0. The results showed that rivers located in the highland areas having various reach types consist of variety of particles sizes from coarse sand to large cobbles with the mean sediment size (d_{50}) ranged from 2mm to 160mm . In contrary, sand bedded streams having bed material that is mostly less than 2mm present dominantly in rivers at the middle gradient (d_{50} ranging from 1mm to 5mm) and low gradient (d_{50} ranging from 0.1mm to 0.2mm). The variation in particle sizes in a sediment mixture is described with a gradation curve which is a cumulative size frequency distribution curve showing particle size versus accumulated percent finer by weight. The average mean particle size, d_{50} obtained in this study ranges from 1mm to 180mm. Performance Test was conducted to evaluate 30 of the existing equations that were developed to compute the value of a bed roughness coefficient for a reach or a cross section. 19 of the equations were able to predict Manning's *n* coefficient while 8 equations determined the Weisbach's *f* coefficient and the remaining 3 equations determined Chezy's C coefficient. Pacheco-Ceballos (1998) gave the highest percentage of 48% (especially in the highland areas having water-surface slope within 0.0005m/m to 0.0177 m/m and particles size, d_{90} that varies from 3.2mm to 180mm) where 43 out of 90 data falls within the discrepancy ratio of 0.5-2.0. For Middle Gradient River, Chang (y_o/d_{50}) 2006 came out with 83% from the Performance Test after being tested for rivers with water-surface slope ranging from 0.001m/m to 0.023m/m, with bed consisted mostly of sand. A user-friendly predictor tool was developed using Microsoft Excel Spreadsheet, where users could input hydraulic and bed material database as measured at-site while the predictor tool assists in determining the best performing equation to estimate the bed roughness coefficients for flow calculations.

5.3 Introduction

Basically, all hydraulics computations involving flow in open channels require an evaluation of the roughness characteristics of the channel. However at present state of