Max Q

Technical Bulletin No 6

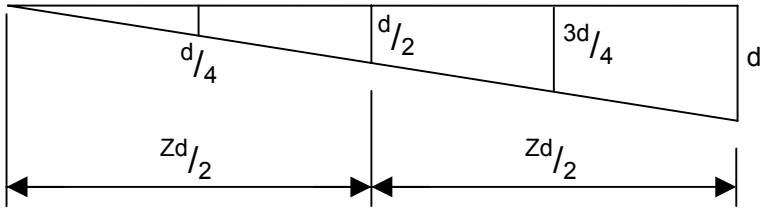
ROAD FLOW FORMULA

INTRODUCTION

The Izzard Equation for calculation of roadway flows is often presented without any explanation of its derivation or any justification for its likely accuracy. It is in fact the familiar Manning Channel Flow Formula applied to a channel of triangular shape. For that reason roughness coefficients to be used are the familiar Manning coefficients.

MANNING FORMULA

The Manning Formula, $Q = 1/n \cdot R^{2/3} \cdot S^{1/2} \cdot$ [area of x-section], for a triangular channel, may be expressed in terms of Depth d, and Crossfall Z, by dividing the cross section into two equal widths, average depth (R) for each measured at the quarter points and Q calculated as follows:

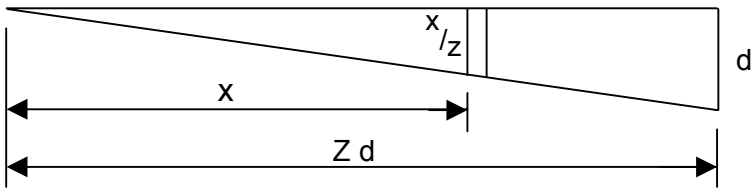


$$Q = 1/n \cdot (d/4)^{2/3} \cdot S^{1/2} \cdot (d/4 \,.\, Zd/2) + 1/n \cdot (3d/4)^{2/3} \cdot S^{1/2} \cdot (3d/4 \cdot Zd/2)$$

$$Q = 0.359 \cdot Z / n \cdot d^{8/3} \cdot S^{1/2} \quad \text{.....(1)}$$

IZZARD EQUATION

A theoretically more precise form of Manning is obtained by integration of flows over the width.



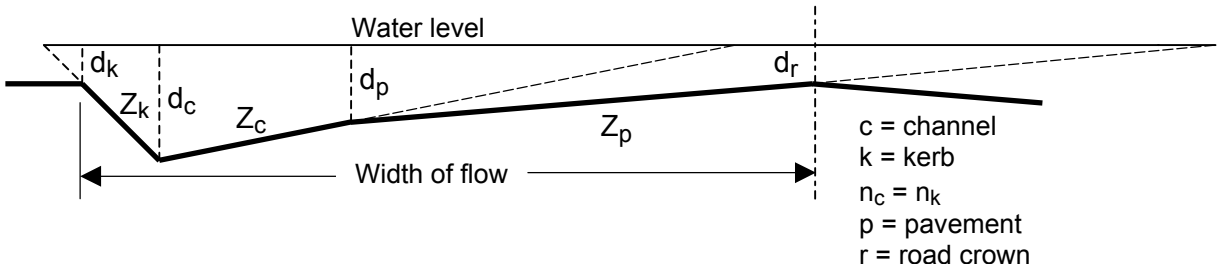
$Q_{\text{(vertical strip of width } \delta x)} = (1 / n \cdot (x/z)^{2/3} \cdot S^{1/2}) \cdot (x/z \,.\, \delta x)$ and integrating from 0 to Zd

$$Q = \int_0^{Zd} 1 / n \cdot (x/z)^{5/3} \cdot S^{1/2} \cdot \delta x \quad \text{giving} \quad Q = [1/ n \cdot (1/z)^{5/3} \cdot 3/8 \,(x/z)^{8/3} \cdot S^{1/2}]$$

$$Q = 0.375 \cdot Z / n \cdot d^{8/3} \cdot S^{1/2} \quad \text{.....(2)}$$

This is the Izzard equation. In both (1) and (2) some 85% of the flow is contained in the deepest half section.

The simple Izzard Equation may be applied by a process of addition and subtraction of triangular elements to derivation of a more complex equation for a flow cross-section made up of a number of triangular parts, as shown in the example below.



For a half road width of flow d_k to d_r = Q:

$$Q = 0.375 [Z_k / n_c \cdot (d_c^{8/3} - d_k^{8/3}) + Z_c / n_c \cdot (d_c^{8/3} - d_p^{8/3}) + Z_p / n_p \cdot (d_p^{8/3} - d_r^{8/3})] S^{1/2}$$

For reference, if a name for the formula is thought necessary, it might possibly be called the Max Q/Izzard equation.

FORM FACTOR

Qudm suggests that for, n_c =0.013 and n_p = 0.015, a form correction factor of 0.9 be applied, to the Izzard formula result, giving the same answer as increasing n_c to 0.0145 and n_p to 0.0167.

ROAD FLOW DESIGN AID

The roadflow design aid, for calculation of Qudm allowable roadway flows which may be downloaded from this site, is based on use of the Izzard Equation using the addition and subtraction of triangular flow cross-sections. The design aid calculations may be made with or without the form factor.

Manning grate capturing roadway flow