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BED LOAD TRANSPORT WITHOUT DEPOSITION IN CHANNELS OF CIRCULAR CROSS SECTION

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ABSTRACT: This paper is based on extensive new experimental investigations of bedload transport of noncohesive sediments in smooth and rough beds of pipe channels with no deposition. Using this new as well as previously available data an attempt has been made to review the current design practice for sewers by comparing the newly derived relationship with the alternative ones that exist in fixed boundary conveyances.

1. INTRODUCTION

Storm sewers are presently designed to be self-cleansing. All sediments entering the sewers are expected to move continuosly along the sewer inverts without any deposition. Current practice for the design of self-cleansing sewers is to ensure that either the flow velocity or the shear stress produced by the flow exceeds a certain limiting value. Typical minimum values are in the range of 0.75m/s to 1.0m/s for velocity and 1.0 N/m^2 to 4.0 N/m^2 for shear stress.

Recent work (Mayerle et.al 1991, May et.al 1989) shows that single velocity or shear stress criterion overestimates the required slope for small sewers and underestimates the slope for large sewers. Both works suggest that self-cleansing conditions depend on several factors such as sediment concentrations, particle size and pipe diameter. Factors such as the shape of the cross-section and roughness of the channel boundary may add further dimension to this problem.

Ackers (1991, 1984) generalises the Ackers-White formula (1973) for loose bed channels to pipe channels which allows for the deposition to occur in the invert of sewers. His proposed relationship is supported by the limited work with small deposition carried out by May et.al (1989).

In this paper the current design practice was re-examined with the relationships obtained from new experiments which cover much wider ranges of data. Similar comparisons were made with past work.

2. EXPERIMENTAL EQUIPMENT AND PROCEDURE

The investigations reported in this paper were conducted in three tilting pipe channels of 154, 305 and 450mm dia. and 20.5m long with smooth beds. Graded sand and gravel of diameters ranging from 0.5mm to 8.3mm with average density of 2550 kg/m^3 were used. All experiments were carried out under part full conditions covering proportional flow depths (y/D) range of 0.15 to 0.8. The range of flow Reynolds numbers