Book reviews

Hydraulic Processes on Alluvial Fans

by R. H. French

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This monograph is intended to meld the understanding of flooding processes on alluvial fans as seen from the viewpoints of the geologist and the engineer. A brief introduction covers the damages resulting from flood flows and debris flows on alluvial fans. Basic geological concepts are then followed by a discussion of open channel hydraulics. Next the various models of hydraulic processes on alluvial fans are discussed, including physical and mathematical models. Finally, the assessment of flood hazards on alluvial fans is discussed.

Floods on alluvial fans in the arid southwest of the United States are a major problem, and it is there that the author finds most of his illustrative examples. Where floods are most likely to hit is where people seem to insist on building. The coverage of the geological properties is fairly complete, but is marred somewhat by the geologists' lack of quantitative theories to go with their qualitative results. French states that "in general it would seem that the alluvial fans of Pakistan are reasonably similar to those found in the American West from the viewpoints of radius and slope." However, his figures indicate that the Pakistan fans are shorter and certainly flatter. Also, equation 2.3.5c does not agree with Fig. 2.3.3(3), and must have a typographical error.

The Huerfano is an unfortunate choice for use in hydraulic geometry studies or to attack them. The Huerfano is subject to side scour at the gauge site. However, hydraulic laws apply. The rating is discontinuous, but a rational explanation can be found if the velocity is plotted against hydraulic radius. This was illustrated in Dawdy (1961). Therefore, comparing that site to a theory based on a concept of quasi-equilibrium is attacking a straw man. Hydraulic geometry is best applied in a "between-streams" context, not "at-a-site". At a site, standard hydraulics may prevail over long periods, if the site is in quasi-equilibrium. In order to use a concept one must understand it. In order to attack it, one must either understand it thoroughly or not at all.

The resistance equations 3.3.3a to 3.3.3e should be replaced by the Prandtl equation (Limerinos, 1970; Burkham & Dawdy, 1976). Upper regime flows for sand channel streams agree with the Prandtl equation for pipe flow because the major source of resistance is grain roughness. The form roughness of the dunes has been washed out. The hydraulics at a site must be understood in order to use the regime equations between sites intelligently.

The Rio Puerco, used by Leopold & Maddock, is an incised stream which has formed its own channel, and is properly in quasi-equilibrium. Further, it is almost always in upper regime because of the high charge of montmorillonite clay it carries. Thus, it is a proper stream for use in channel geometry studies. There are many cases recorded where a major flood radically changed a channel system. What is the equilibrium discharge for such a stream? Is the equilibrium shape that for before or after the flood? The Knighton example may have been for a stream that had an approximately rectangular channel which obeyed Manning's equation prior to the flood (f = 0.6?). After the flood, the rating could have become indeterminate (f = 0.2?). The banks may have become highly unstable, or else there is overbank flow at a low stage. However, without an explanation of Knighton's Fig. 3.4.5 there is no way to know.

The discussion of models of alluvial fans is excellent. In particular, the description of Price's stochastic model on a geological scale is good, and the conclusion that the model should be extended by further refinement is welcome. Similarly, the discussion of the qualitative physical models of Hooke gives insight into the modelling problems. The discussion of modelling is worth the cost of the book.

As the author of the FEMA approach, I must state that French's equation 3.4.21 does hold for the FEMA method, as $9.5 \times 0.07 \times 1.5 = 0.9975$ which is equal to 1.0 but for rounding (Table 3.4.1). The FEMA equation quoted on page 194 is a depth which includes velocity head, so the coefficient is 1.5 times the regime depth. Also, the choice by FEMA of log Pearson III for the flood frequency distribution at the apex is operational. Any distribution may be assumed, but the transformation to achieve a closed form solution will be different or nonexistent.

The recommendations in the final chapter are excellent. It is quite true that "one cannot be too optimistic regarding the willingness ... of governmental units" to undertake "the critical research and data needs required to understand hydraulic processes on alluvial fans ..." However, this book helps to define those needs, and, in addition, it was fun to read. Although it focuses too narrowly on a limited geographical area, the insights it contains are applicable throughout the arid regions where alluvial fans are common, and where people are bound to build on them.

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Glacio-Fluvial Sediment Transfer: an Alpine Perspective *edited by A. M. Gurnell & M. J. Clark*

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This narrowly-titled book attempts to provide what the editors describe as an