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# Cross-Circulatory Motion and Related Effect of Width-to-Depth Ratio on the Bed Deformation in Meandering Streams

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**Abstract**

The flow in meandering streams exhibiting a downstream variation in curvature (such as sine-generated channels) can be regarded as consisting of a convective "base" upon which a cross-circulatory motion is superimposed. The convective base, which emerges because of the variation in curvature, is formed by fluid mass which shifts (in all its thickness) periodically left and right as the flow is conveyed downstream. The cross-circulatory motion, on the other hand, is due to the stream curvature.

It follows that in such streams the bed deformation occurs as a result of two different mechanisms: convective acceleration-deceleration of flow, and action of cross-circulatory motion on the bed. Since in a sinuous channel the convective acceleration is present for all values of the width-to-depth ratio ($B/h$-ratio), whereas the intensity of cross-circulation progressively decreases with increasing values of $B/h$, there must exist a (critical) value of $B/h$ beyond which the effect of cross-circulation becomes of secondary importance where the bed deformation is concerned. This paper is intended as a contribution to reveal such critical value of $B/h$. This appears as particularly worthwhile, as a number of authors, and most prominently M.S. Yalin, have in the past pointed out that the importance of cross-circulation in determining meandering bed deformation is routinely over-emphasized when dealing with natural meandering streams.

The present analysis is based on an extensive series of laboratory experiments carried out by the authors in sine-generated streams of varying sinuosity, as well as all available data from the literature. While enabling the determination of the critical value of $B/h$, this work also demonstrates that this is a function of stream sinuosity and flow relative depth.

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