
FLOW AROUND STREAM BENDS

GLADYS E. BRADEN, University of Oklahoma, Norman

ABSTRACT

In addition to helicoidal flow, other important flow patterns exist at stream bends. One pattern has the thread of greatest velocity along the inner or convex bank, not the concave. Deposition takes place along the outer bank and cutting along the inner. Streams having hairpin turns, that is, bends approaching 180 degrees, have such a flow pattern. Another pattern has both cutting and deposition along the concave bank. Both cutting and deposition are brought about by a current that moves upstream along the concave bank within the bend area. The upstream-moving current is part of an eddy current that arises within the bend because of an abrupt expansion in channel width. This expansion causes the stream to lose kinetic energy and gain potential. A greater amount of potential energy at some downstream locus than at some place upstream causes upstream flow down the pressure gradient. There are numerous examples of this type of flow.

This latter type of flow pattern is noteworthy because of the stream-bank erosion and channel widening associated with it. Eddy currents modify the meander pattern since they scallop the concave bank. Eventually small meanders are developed on the larger meanders so that the stream becomes more winding. Vortices, which may form along a line of demarcation between the main downstream flow and that part of the eddy current that moves upstream against the concave bank, cause potholing and stream fluting in incised streams and channel deeps in floodplain streams. Vortices are important agents of channel deepening. Channel islands are formed along the concave bank in regions of slacker water because of eddy-current action. Modifications of the flow pattern which take place after the formation of a channel island may weaken the eddy current and so cause the island to cease growth after it has reached some critical size.