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An exact solution for cohesive critical tapers derived from Mohr diagrams

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The idea that the outer parts of mountain belts, the foreland fold-and-thrust-belts or accretionary wedges display the large-scale geometry of a taper exists since the early 1900's. Following up on the paper by Davis, Suppe, and Dahlen (1983), Dahlen (1984) produced his well-known exact solution for a critical non-cohesive Coulomb wedge. This solution was recovered a little later by Lehner (1986) through an alternative method, based on the concept of a 'Rankine limit stress state' (as familiar from soil mechanics) and the use of Mohr's stress circle. An advantage of this method lay in the simplicity in which the critical wedge problem was solved, both graphically and analytically. Here we briefly review the principle steps in the Mohr-circle construction and the notion of passive or active Rankine limit stress states in an infinite sloping half-space. We then give the exact solution for such states of the problem of critical cohesive Coulomb wedges in an overpressured uniformly sloping half-space. While an approximate solution of Dahlen et al. (1984), for small taper angles, demands an upward convex surface, cohesive Rankine state solutions require curved detachments, in agreement with curved slip lines, in the shallower part of a cohesive Coulomb plastic slope.