# Three-dimensional Flows

Though numerical methods seem to be in the ascendant, several efforts have been made to treat three-dimensional cavity flows analytically. Early analyses of attached cavities on finite aspect ratio foils combined the solutions for planar flows with the corrections known from finite aspect ratio aerodynamics (Johnson 1961). Later, stripwise solutions for cavitating foils of finite span were developed in which an inner solution from either a linear or a nonlinear theory was matched to an outer solution from lifting line theory. This approach was used by Nishiyama (1970), Leehey (1971), and Furuya (1975b) to treat supercavitating foils and by Uhlman (1978) for partially cavitating foils. Widnall (1966) used a lifting surface method in a three-dimensional analysis of supercavitating foils.

For more slender bodies such as delta wings, the linearized procedure outlined in section (Nug) can be extended to three-dimensional bodies in much the same way as it is applied in the slender body theories of aerodynamics. Tulin (1959) and Cumberbatch and Wu (1961) used this approach to model cavitating delta wings.