The subject of this thesis is modelling and numerical simulation of the interaction of two–dimensional incompressible viscous flow and a vibrating airfoil. A solid airfoil with two degrees of freedom, which can rotate around the elastic axis and oscillate in the vertical direction, is considered. The numerical simulation consists of the finite element solution of the Navier–Stokes equations coupled with the system of ordinary differential equations describing the airfoil motion. The time dependent computational domain and a moving grid are taken into account with the aid of the Arbitrary Lagrangian–Eulerian (ALE) formulation of the Navier–Stokes equations. High Reynolds numbers up to 106 require the application of a suitable stabilization of the finite element discretization and application of a turbulent model. We apply the algebraic turbulent models, which were designed by Baldwin and Lomax and by Rostand. As a result a sufficiently accurate and robust method is developed, which was tested by the simulation of flow along a flat plate and applied to the computation of pressure distribution along the airfoil with forced vibrations.