ABSTRACT

In the present work, an attempt has been made to develop numerical codes for the solution of viscous separated flow past bodies of arbitrary shapes. The investigation has been carried out for both 'closed bubble type' and 'free shear layer type' separated flows.

For closed bubble type separation, Navier-Stokes solvers have been developed for calculating two-dimensional incompressible and compressible flows at low Reynolds numbers. For these two cases, distinctly different explicit, finite-volume solvers have been developed. The solvers are based on primitive variable formulation using body-fitted coordinates and solutions of full Navier-Stokes equations have been obtained in the physical plane itself without using any transformation to computational plane.

Using the incompressible Navier-Stokes solvers, results have been obtained for a square cylinder and NACA0012 aerofoil. The compressible flow solver, on the other hand, has been applied to NACA0012 aerofoil only. To access the numerical accuracy of the solution, the results have been compared with numerical and experimental results available in the literature. The computed results agree reasonably well with the available results.

For free shear layer type separation, potential flow solvers have been developed for calculating three-dimensional incompressible inviscid flows at high Reynolds numbers. The solvers are based on unsteady vortex lattice concept using closed vortex ring elements instead of the conventional horse-shoe vortices. The solvers have been applied to study the leading edge separated flow about double-delta and canard wing configurations.

Experimental investigations have also been carried out for these two configurations. The experimental work involves measurement of overall forces and moments as well as surface pressure distribution on a number of models. Numerical results obtained by potential flow solvers agree well with the experimental results.