This thesis presents a finite element computational method for solving incompressible viscous flow problems. This incompressible viscous flow can be classified into two types namely: the flow without inertia for slow moving fluid, and with inertia for a more general flow.

Finite element equations corresponding to these two types of flows were derived from the governing Navier-Stokes differential equations using the Galerkin method of weighted residuals. These derived finite element equations were then used in the development of the two computer programs. The programs were verified by solving academic-type problems that have exact solutions before applying to solve more realistic problems.

These problems have demonstrated the capability of the finite element method that can provide detailed flow behavior past complex geometries. Such results can help analysts to further understand the complex flow behavior in order to improve the design.

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