The purpose of this paper is to present a variational approach for two-dimensional large strain static analysis of marine risers. The model formulation is developed in Cartesian coordinate system, in which deformation is described based on Lagrangian mechanics. The variational model formulation involves strain energy due to bending and axial stretching, and virtual work done by hydrostatic pressures and other external forces. The nonlinear static problem is numerically solved by using the finite element method.

As an independent check for the validation of the variational approach, equilibrium equations based on the vectorial approach are developed and solved by the shooting method. Numerical examples are given to demonstrate the effect of large strain on the large displacement static behavior of marine risers.