

STUDY OF THE VORTICITY-VELOCITY-PRESSURE  
FORMULATION OF THE STOKES PROBLEM:  
BIHARMONIC PROBLEM

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**Abstract:** In this work we propose the vorticity, velocity and pressure mixed formulation of the Stokes problem in a square or a cube provided with non-standard boundary condition which involve the normal component of the velocity and the tangential components of the vorticity. We apply the curl to the Stokes equations by bringing it to a biharmonic equation (bi-Laplacian), and we present numerical experiments which confirm the analysis.

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**Key Words:** Stokes equation, biharmonic equation

## 1. Introduction

The flow of an incompressible viscous fluid in a domain  $\Omega$  from  $\mathbb{R}^d$  is characterized by two variables: the velocity  $\mathbf{u}$  and the pressure  $p$ . It is governed by two equations when the flow is stationary, can be written as follows:

(i) The momentum equation

$$-\nu\Delta\mathbf{u} + \operatorname{grad}p = \mathbf{f} \quad \text{in } \Omega. \quad (1)$$