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Study of a Non-Isothermal Hooke Operator in Thin Domain with Friction on the Bottom Surface

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Abstract: This work is focused on the study of the asymptotic behavior of a coupled problem that consists of an elastic body and the change of heat. The friction exerted on the body is nonlinear of Coulomb type in a thin domain $\Omega^\varepsilon \subset \mathbb{R}^3$. As a first step, we give the variational formulation of the problem and the establishment of the existence and uniqueness results for the weak solution. We proceed to the asymptotic analysis. To do this, we use the scale change following the third component and new unknowns to conduct the study on a domain Ω independent of ε. Then we prove some estimates for the displacement and the temperature. Finally, these estimates allow us to have the limit problem and prove the uniqueness of the solution.

Keywords: *a priori inequalities; boundary conditions; Coulomb law; coupled problem; elastic body; Fourier law.*

Mathematics Subject Classification (2010): 35R35, 76F10, 78M35, 70K45, 70K20, 93-00, 70K20.

1 Introduction

In solid mechanics, thin structures are widely used in several fields of industry, for example, in underwater industry, aerospace, civil engineering and in common constructions, in the field of energy, industrial design, and even in the living world. We also find the use of thin structures in the metallurgical industry, in particular in the rolling process of thin sheets etc. More details can be seen in [1]. In mathematical literature, the problems in thin areas and especially in the elasticity of thin films, plates and shells have already been studied for more than a century. For example, Ciarlet in [10] and Destuynder in [12] have studied the equilibrium states of a thin plate $\Omega \times (-\varepsilon, +\varepsilon)$ under external forces, where Ω is a smooth domain in $\mathbb{R}^2$ and ε is a small parameter, to justify the

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