Harmonic Vibration of Cusped Prismatic Shells in the Nth Hierarchical Model

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Abstract

We study the well-posedness of boundary value problems for elastic cusped prismatic shells in the N-th approximation of I.Vekuas hierarchical models (for Vekua's models see e.g., Jaiani, G. Cusped Shell-like Structures, SpringerBriefs in Applied Science and Technology, Springer-Heidelberg-Dordrecht-London-New York, 2011 and references therein) under (all reasonable) boundary conditions at the cusped edge and given displacements at the non-cusped edge and stresses at the upper and lower faces of the shell. Special attention is drawn to the $N = 0, 1$, approximations as to important cases from the practical point of view, e.g., $N = 0$ and $N = 1$ models, actually, coincide with the plane deformation and Kirchhoff-Love model, respectively. We consider harmonic vibration of the plate with the thickness $2h(x_1, x_2) = h_0 x_2^{\kappa}$, $h_0 = const > 0$, $\kappa = const \geq 0$, $x_2 \geq 0$ and with an oscillation frequency ν. For arbitrary $\kappa \geq 0$ we introduce appropriate function spaces $X^{\kappa}_{N,\nu}$ which are crucial in our analysis. We show coerciveness of the corresponding bilinear form and prove uniqueness and existence results for the variational problem. We describe in detail the structure of the spaces $X^{\kappa}_{N,\nu}$ and establish their connection with weighted Sobolev spaces. Moreover, we give some sufficient conditions for a linear functional arising in the right hand side of the variational equation to be bounded.

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