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Thin Elastic Plates Supported over Small Areas. II: Variational-Asymptotic Models

An asymptotic analysis is performed for thin anisotropic elastic plate clamped along its lateral side and also supported at a small area θ_h of one base with diameter of the same order as the plate thickness $h \ll 1$. A three-dimensional boundary layer in the vicinity of the support θ_h is involved into the asymptotic form which is justified by means of the previously derived weighted inequality of Korn's type provides an error estimate with the bound $ch^{1/2} |\ln h|$. Ignoring this boundary layer effect reduces the precision order down to $|\ln h|^{-1/2}$. A two-dimensional variational-asymptotic model of the plate is proposed within the theory of self-adjoint extensions of differential operators. The only characteristics of the boundary layer, namely the elastic logarithmic potential matrix of size 4×4 , is involved into the model which however keeps the precision order $h^{1/2} |\ln h|$ in certain norms. Several formulations and applications of the model are discussed.

Keywords: Kirchhoff plate, small support zone, asymptotic analysis, self-adjoint extensions, variational model.

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