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Boundary layer resolution in hierarchical plate modelling. (English) Zbl 0821.73030

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Summary: The dimensional reduction of an elliptic model boundary value problem on a thin, plate-like domain of thickness $2d$ is analysed. A class of lower-dimensional models with variable model orders in the interior and near the boundary of the plate is investigated and it is shown that for a sufficiently large model order in a $O(d|lnd|)$- neighbourhood of the edge the hierarchical models compensate for the boundary layers of the exact solution – in the sense that their asymptotic rate of convergence as $d \to 0$ is the same as the optimal one for compatible, layer-free solutions.

MSC:

74K20 Plates
35B25 Singular perturbations in context of PDEs

Keywords:

elliptic model boundary value problem; lower-dimensional models; asymptotic rate of convergence

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References:

[1] and , 'Survey lectures on the mathematical foundation of the finite element method', in: The mathematical foundations of the finite element method with applications to partial differential equations (ed.) pp. 3-343, Academic Press, New York, 1972.· doi:10.1016/B978-0-12-068650-6.50006-X

[2] Babuška, SIAM J. Num. Anal. (1994)

[3] Plates and Junctions in Elastic Multistructures, Masson, Paris; Springer, New York, 1990.

[4] Jensen, SIAM J. Numer. Anal. 29 pp 1294– (1992)

[5] Morgenstern, Arch. Rat. Mech. Anal. 4 pp 145– (1959)

[6] Les Méthodes Directes en Théorie des Equations Elliptiques, Masson, Paris, 1967.

[7] and , 'Energy estimates relating different linearly elastic models of a cylindrical shell, part I: the membrane-dominated case, part II: The bending-dominated case, part III: the soft membrane case; Reports A 286, A 293 and A 299', Institute of Mathematics, Helsinki University of Technology, Espoo, Finland, 1991.

[8] 'Hierarchic Models of Elliptic Boundary Value Problems on Thin Domains–a-posteriori Error Estimation and Fourier Analysis', Habilitation Thesis, Stuttgart University, 1994.

[9] and , 'Boundary layer approximation in hierarchical beam- and plate models'; Research Report 92-08, Department of Mathematics, University of Maryland, Baltimore County, Baltimore, MD 21228-5398, May 1992 (in press in J. Elasticity).

[10] Singular Integrals and Differentiability Properties of Functions, Princeton University Press, Princeton, NJ, 1970. · Zbl 0207.13501

[11] Vogelius, Math. Comp 37 pp 31– (1981)