English summaries

Rakenteiden Mekaniikka (Journal of Structural Mechanics)
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Is the chapel roof firm enough?
An accuracy test of old computational models

Juhani Pitkäranta

Summary. We discuss mathematical models for a shell roof consisting of a thin spherical shell and a stiffening ring attached to its edge. The problem is to find the stress resultants at the junction of the shell and the ring as caused by the dead weight of the roof. We consider in detail a textbook example presented in K. Girkmann: Flächentragwerke, 3rd esition, Springer 1954, pp. 421--425. We go thhrough the old hand computation methods to solve the problem and study various possibilities of improving the accuracy of these methods. The starting point in the old methods is the 2D linear elastic theory taking into account the rotational symmetry of the problem. By dimension reductios the 2D theory is simplified first to a model combining 1-dimensional shell theory with 0-dimensional ring theory. Within the reduce model, various further simplifications are made in hand computation. At the end of the article we present an accuracy test where as a reference we use a numerical 2D result computed by hp-FEM.

Key words: dimension reductions, shells, rings, FEM

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Error analysis for laminated composite Reissner-Mindlin plates

Juho Könnö

Summary. We present a general technique for the error analysis of laminated composite plates employing first-order laminate theory and the finite element method. We show that by using equal-order approximations for the plate and plane elasticity problems we arrive at an optimally-convergent finite element method for the coupled problem.

Key words: laminated composite, plate, Reissner-Mindlin, finite elements

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Amphora – Classical shell structure

Harri Hakula and Tomi Tuominen

Summary. In this work a new *hp*-adaptive algorithm, which is based on a combination of energy and Sobolev regularity considerations, is discussed. Performance of the algorithm in both 1D- and 2D-problems is demonstrated in the context of a challenging problem, the amphora. Elliptic shells of revolution under mixed boundary conditions are subject to a phenomenon, complexification, where the displacements are dominated by a global oscillation in the angular direction. This oscillation has a characteristic wave number proportional to a parameter -log *t*, where *t* is the relative thickness of the shell. It is shown that the phenomenon occurs also if the elliptic part is extended with a hyperbolic one and the oscillations are transmitted along the characteristics of the hyperbolic surface.

Key words: shells, finite element method, *hp*-adaptivity, numerical locking