Wu, Chih-Ping; **Liu, Chi-Chuan**

An asymptotic theory for the nonlinear analysis of laminated cylindrical shells. (English)

Zbl 1083.74560
Int. J. Nonlinear Sci. Numer. Simul. 2, No. 4, 329-342 (2001).

Summary: On the basis of three-dimensional (3D) nonlinear elasticity, an asymptotic theory is developed for the analysis of multilayered anisotropic circular cylindrical shells. The nonlinear relations between the finite strains (Green strains) and displacements, the nonlinear equilibrium equations in terms of the Kirchhoff stress components, and the generalized Hooke's law for a monoclinic elastic material are considered in the present formulation without making a priori static or kinematic assumptions. By means of proper nondimensionalization, asymptotic expansion and successive integration, recursive sets of the governing equations for various orders are obtained. It is shown that the von Kármán nonlinear theory is derived as a first-order approximation to the 3D nonlinear theory. The differential operators in the linear terms of governing equations for various orders remain identical, the nonlinear terms related to the unknowns of the current order appear in a regular pattern, and the other nonhomogeneous terms can be calculated by the lower-order solutions. With the sets of appropriate edge conditions, the nonlinear analysis of laminated cylindrical shells can be made in a hierarchic and consistent way.

MSC:

74K25 Shells
74E30 Composite and mixture properties
74G10 Analytic approximation of solutions (perturbation methods, asymptotic methods, series, etc.) of equilibrium problems in solid mechanics

Keywords:

nonlinear analysis; cylindrical shells; 3D elasticity; asymptotic theory; perturbation

Full Text: DOI

References:

[1] DOI: 10.1007/BF00045486 · doi:10.1007/BF00045486
[2] DOI: 10.1016/0020-7462(88)90013-3 · Zbl 0637.73041 · doi:10.1016/0020-7462(88)90013-3
[3] DOI: 10.1016/S0020-7683(99)00011-6 · Zbl 0992.74025 · doi:10.1016/S0020-7683(99)00011-6
[4] DOI: 10.1016/S0020-7403(97)00029-5 · Zbl 0901.73043 · doi:10.1016/S0020-7403(97)00029-5
[5] DOI: 10.1016/0020-7403(94)E0011-7 · Zbl 0827.73040 · doi:10.1016/0020-7403(94)E0011-7
[6] DOI: 10.2514/3.8932 · doi:10.2514/3.8932
[7] DOI: 10.1115/1.3151873 · doi:10.1115/1.3151873
[8] DOI: 10.1115/1.3149544 · doi:10.1115/1.3149544
[9] Widera G.E.O., ASCE 106 pp 1053– (1980)
[10] Logan D.L., ASCE 106 pp 1075– (1980)
[11] Wu C.P., ASCE 122 pp 391– (1996)
[12] DOI: 10.1016/0020-7683(95)00242-1 · doi:10.1016/0020-7683(95)00242-1
[13] DOI: 10.1115/1.2900738 · Zbl 0800.73225 · doi:10.1115/1.2900738