ON FREE VIBRATIONS ANALYSIS OF CYLINDRICAL CANTILEVER

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The method for analysis of free linear vibrations of cantilever cylindrical shell is suggested. The calculations of eigenmodes are the first step for analysis of nonlinear problem. The Rayleigh- Ritz method is the basis of the suggested approach. Strains and stresses of the shell satisfy the Hooke's law; shear and rotary inertia are not taken into account. The radial, longitudinal and circumference displacements W,U,V takes the following form:

$$\begin{aligned} W(x,\theta,t) &= \tilde{W}(x,\theta)\sin\omega t; \\ U(x,\theta,t) &= \tilde{U}(x,\theta)\sin\omega t; \\ V(x,\theta,t) &= \tilde{V}(x,\theta)\cos\omega t, \end{aligned} \qquad (1)$$

where x,θ are longitudinal and circumference coordinates of cylindrical shell; ω is frequency of vibrations. The functions $\tilde{W}(x,\theta)$, $\tilde{U}(x,\theta)$, $\tilde{V}(x,\theta)$ are presented in the form of double series:

$$\begin{aligned} \tilde{W}(x,\theta) &= \sum_{m=1}^{N_1}\sum_{n=1}^{N_2} W_{m,n}\,\phi_m(x)\cos(n\theta); \\ \tilde{U}(x,\theta) &= \sum_{m=1}^{N_3}\sum_{n=1}^{N_4} U_{m,n}\,\chi_m(x)\cos(n\theta); \\ \tilde{V}(x,\theta) &= \sum_{m=1}^{N_5}\sum_{n=1}^{N_6} V_{m,n}\,\chi_m(x)\sin(n\theta), \end{aligned} \qquad (2)$$

where $\phi_m(x), \chi_m(x)$ are beam functions; $W_{m,n}; U_{m,n}; V_{m,n}$ are unknown coefficients, which are obtained by Rayleigh- Ritz method.

The vibration of clamed-free cylindrical shell are numerically investigated . The solution is obtained solving numerically an eigenvalue problem. The properties of the eigenmodes are analyzed. The results of the calculations are compared with the data, obtained by the finite element software ANSYS, and with the results, published by Leissa [1] and by Kurilov and Amabili [2] .

References:

1. Leissa.A.W. Vibration of Shells //NASA SP-288, Government Printing Office, Washington DC, 1973.

2. Kurylov.Ye, Amabili .M. Polynomial versus trigonometric expansions for nonlinear vibrations of circular cylindrical shells with different boundary conditions//Journal of Sound and Vibration 329 (2010)1435–1449.).