SECTION XVII. GENERAL MECHANICS AND MECHANICAL ENGINEERING

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INFLUENCE OF THE ELASTICITY OF THE OUTER PLATES ON THE DEFLECTION OF THE ROPE DRUM FLANGES

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The rope drum is a circular plate attached to the outer surface of the hub [1]. They have their own elasticity, which depends on the geometric dimensions of the plates, the material from which they are made, and the conditions of attachment to the drum shell [2].

In this work, the degree of influence of the elasticity of the outer part of the rope drum on the deflection function of the shell is clarified.

Let us determine the integration constants in equation (1) from the following conditions [3]:

$$f(x) = cos(\rho sin\psi x)\left(C_1 e^{\rho cos\psi x} + C_2 e^{-\rho cos\psi x}\right) + Ae^{-k\mu\frac{l-x}{h}2\pi}, \quad (1)$$

no normal stress:

$$\frac{d^2 f(x)}{dx^2} = 0 \text{ at } x=0. \quad (2)$$

The equality of the radial displacements of the shell and the outer plates of the rope drum gives the equation of the mixed variation problem [4]:

$$\frac{\partial \Gamma}{\partial f'} - \frac{d}{dx}\left(\frac{\partial \Gamma}{\partial f'}\right) + \frac{\partial \Gamma_m}{\partial f} = 0, \quad (3)$$

where Γ is the energy of the outer plates of the rope drum,

$$\Gamma_m = \int \frac{M_m^2}{2EJ_0} R df, \quad (4)$$

$$M_m = EJ_0 x_\varphi = \frac{EJ_0}{D_m} f(x) cosn\varphi, \quad (5)$$

where EJ_0 is the bending stiffness of the outer plates of the rope drum.

$$D_m = Ei_m, \quad (6)$$

i_m - linear moment of inertia of the section of the outer plates of the rope drum.

The joint solution of equations (4) and (5) makes it possible to determine new values of the coefficients C_1 and C_2.

$$C_1 = \frac{2+v(n^2-3)-\frac{4\pi^2 k^2 \mu^2 R^2}{h^2}}{J_0 R}, \quad (7)$$

$$C_2 = \frac{\left[\frac{4\pi R^2 k^2 \mu^2}{h^2}+2-v(n^2-3)\right] i_m^2}{J_0 R} \left[\frac{cos\psi L+\rho cos2\psi L}{e^{-\rho(2-cos\psi L)}(cos\psi L+\rho cos2\psi L)}\right]. \quad (8)$$

The solution obtained allows taking into account the geometric and elastic properties of the outer plates for the strength of the drum.

References:

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