

IMPROVING THE THEORETICAL ANALYSIS OF THE DEFORMED STATE OF A CYLINDRICAL SHELL FILLED WITH VOLCANIC RUBBER

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ABSTRACT

As a rule, rubber differs from other structural materials in its ability to stretch strongly. In this case, the sample can be stretched almost to failure without significant permanent deformations.

Keywords: cylinder, density, rubber, material, shell, displacement, strains, stresses, radial, axial, ends, layer, forces, modulus, equation.

Let us consider the problem of deformation of a metal cylindrical shell filled ω with a rubber layer while rotating at a constant angular velocity (Fig. 1).

Let us denote l through the length of the cylinder, R_0 and R the inner and outer radii of the h rubber layer, the thickness of the shell through, the density of the rubber ρ_c and ρ_o the material of the shell, respectively, through and. Set the origin in the middle of the cylinder and direct the axis along $0z$ the axis of the cylinder.

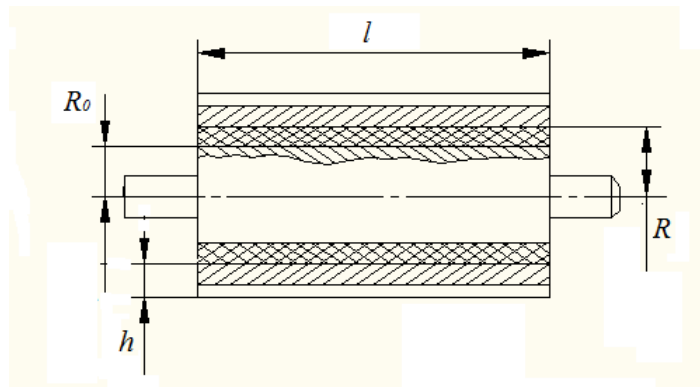


Figure 1: Feeding cylinder with elastic sleeves

Set the origin in the middle of the cylinder and direct the axis $0z$ along the axis of the cylinder. In the absence of external forces in the transverse direction, the axis $0z$ is the axis of symmetry. Let us denote by both radial U_r and U_z axial displacements in an arbitrary section of the layer, the angular displacement in this case will be U_θ equal to zero. To determine the deformations and stresses in the rubber layer, we use the approximate Ritz method. For this purpose, we assume that the cross-section of the layer before and after deformation remains flat, and in the process of deformation, the axial displacement depends only on the U_z coordinate $0z$, then the deformations of the cross-sections of the layer are determined by the formulas

$$\epsilon_r = \frac{\partial U_r}{\partial r}, \epsilon_\theta = \frac{U_r}{r}, \epsilon_z = \frac{\partial U_z}{\partial z}, \gamma_{rz} = \frac{\partial U_r}{\partial z}, \gamma_{r\theta} = \gamma_{z\theta} = 0 \quad (1)$$

The displacements of the shell along the radius and axis of rotation will be denoted by $u_r(z)$ and $u_z(z)$, respectively. Since the volume of the rubber layer is constant, the condition is satisfied, from which, $\epsilon_r + \epsilon_\theta + \epsilon_z = 0$ taking into account (2), it follows

$$\frac{\partial U_r}{\partial r} + \frac{U_r}{r} + \frac{\partial U_z}{\partial z} = 0 \quad (2)$$

According to the assumptions made, $U_z = f(z)$ we assume $U_r = 0$ and $r = R_0$ integrate (3) with the condition at, we obtain.

$$U_r = -\frac{1}{2} f'(z)(r^2 - R_0^2)/r \quad (3)$$

From formula (2) it follows that due to the accepted condition of incompressibility, the axial movement of the rubber does not depend on the radial coordinate. Figure 2 shows similar distribution curves of the axial displacement of the rubber layer (Figure 2) for two values of the cylinder turnover. From the analysis of the curves it follows that the radial and axial displacements of the rubber layer for the case under consideration have the same order and are practically insignificant, therefore, their deformation can be neglected.

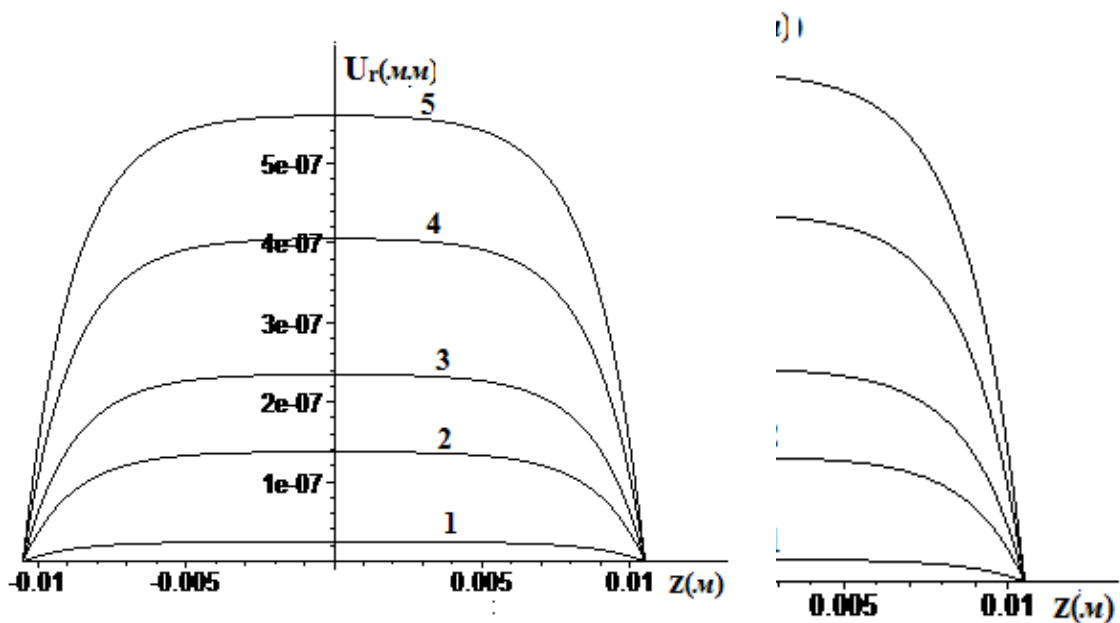


Fig. 2. Distribution of the radial displacement of the layer along the axis of the cylinder for two values of the revolution of the cylinder at different distances from its center: $1 - r = 0.4R$, $2 - r = 0.5R$, $3 - r = 0.6R$, $4 - r = 0.8R$, $5 - r = R$

CONCLUSION

When solving the problems of stability or vibrations of the shells of the supply cylinder, it is necessary to choose such a combination that is consistent with the nature of the expected wave formation and lead to the minimum value of the frequency or critical load.

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