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STABILITY OF AN ORTHOTROPIC CIRCULAR PLATE TAKING INTO ACCOUNT INHOMOGENEOUS RESISTANCE

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Abstract- The theoretical and experimental study of the stability and vibrations of thin-walled plates and shells of various configurations with different physical and mechanical properties in different directions has attracted primary attention due to the widespread use of new materials in various structures, such as plywood, which has a sharp anisotropy. Currently, research in this area is intensively developing, the use of new materials in structures requires new approaches and the creation of new methods for design, and it becomes relevant due to the rapid development and introduction of fiberglass, which are also anisotropic [1]. Note that fundamental research in this area belongs to [2, 3, 4]. One of the possible types of anisotropic plate is orthotropic materials, which are characterized by four independent constants. In many areas of construction of engineering structures, in the operation of oil and gas fields and in the construction of transport structures (for example, in the construction of railways, metro, etc.), it is necessary to take into account the real properties of the environment, which, depending on the terrain, are described by various mathematical models, which also include linear and nonlinear bases, heterogeneous, anisotropic, viscoelastic etc. Taking into account these specific features together with anisotropy and variability of specific density leads to complex mathematical problems, and not taking them into account leads to large undesirable errors. Therefore, the relevance of this work is beyond any doubt.

Keywords: Stability, Round Plates, Heterogeneous Base, Orthotropic Bodies, Bubnov-Galerkin Method.

1. INTRODUCTION

As you know, round plates are one of the more common design elements in engineering practice. Due to the fact that artificially manufactured materials have been widely used in engineering and in the construction of various kinds of construction complexes in recent years, therefore, interest in anisotropic structures has grown quite a lot. As it was noted in the monograph [11], in many cases experiments do not confirm Winkler's hypothesis. However, until now, assuming the linearity of the resistance, the Winkler hypothesis is often used in the research of many authors. Considering the above, to compare Winkler's hypothesis with the solution of the present problem, we will assume that the base is inhomogeneous.

The cases of axisymmetric buckling, when the median plane of the plate passes into the surface of rotation, are of the greatest practical importance. In this article, we will consider similar problems taking into account an inhomogeneous base, in which the resistance force depends on the current radius. We will use a cylindrical coordinate system, the main plane of which is the median plane of the plate. We will assume that the plate is compressed along the entire contour by a radial force intensity (Figure 1).

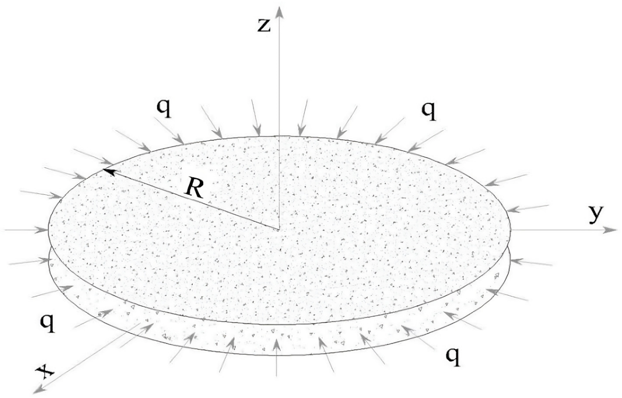

Figure 1. Scheme of uniform load distribution along contour of the plate

2. PROBLEM STATEMENT

Using the relations of the theory of elasticity of orthotropic bodies described in the first chapter, it is not difficult to show that in this case the stability equation (axisymmetric problem), taking into account the inhomogeneous external resistance, has the form:

$$\frac{d^3w}{dr^3}+\frac{c_1}{r}\frac{d^2w}{dr^2}-\frac{c_2}{r^2}\frac{dw}{dr}-\bar{k}(1+\varepsilon\phi(r))w-\bar{q}\frac{d^2w}{dr^2}=0 \qquad (1)$$

The following designations are introduced here:

$$\overline{q} = qD_1^{-1}\ ,\ \ c_1 = 1+\nu_1 - \alpha\nu_2\ ,\ \ c_2 = 1+\nu_2-\alpha\nu_1$$

$$D_1 = \frac{E_1 h^3}{12(1-\nu_1\nu_2)}\ ,\ \ D_2 = \frac{E_2 h^3}{12(1-\nu_1\nu_2)} \tag{2}$$

$$\overline{k} = kD_1^{-1},\ \ \alpha = D_2 D_1^{-1}$$

where, k is the Winkler coefficient, $\varepsilon\in[0,1]$, $\varphi(r)$, continuous function, ν_1, ν_2 and E_1, E_2 are accordingly, the Poisson coefficients and elastic modulus in the main directions.

The solution of Equation (1) can be constructed by one of the approximate analytical methods. As noted in [9], when solving such stability problems, the Bubnov-Galerkin method is the most effective and proven. As is known in engineering practice, they are usually satisfied with determining the value of the critical load in the first approximation and according to [4, 5, 6] for an orthotropic plate we have:

$$-P_{kp}^{0} = \frac{\int_0^a\int_0^b\left[D_{11}\frac{d^4\phi_1}{dx^4}\psi_1 + 2(D_{16}+D_{66})\frac{d^2\phi_1}{dx^2}\frac{d^2\psi_1}{dy^2} + D_{22}\frac{d^4\phi_1}{dx^4}\psi_1\right]\phi_1\psi_1\,dxdy}{\int_0^a\int_0^b\left(\frac{d^2\phi_1}{dx^2}\phi_1\psi_1^2 + \beta\frac{d^2\psi_1}{dy^2}\phi_1^2\psi_1\right)dxdy} + \tag{3}$$

$$+\frac{k\int_0^a\int_0^b\left(1-a_1\overline{x}+a_2\overline{x}^2\right)\phi_1^2\psi_1^2\,dxdy}{\int_0^a\int_0^b\left(\frac{d^2\phi_1}{dx^2}\phi_1\psi_1^2 + \beta\frac{d^2\psi_1}{dy^2}\phi_1^2\psi_1\right)dxdy}$$

Without taking into account the resistance of the external inhomogeneous medium, respectively we obtain:

$$-P_k^{\delta} = \frac{\int_0^a\int_0^b\left[\begin{array}{l} D_{11}\frac{d^4\phi_1}{dx^4}\psi_1 + 2D_{16}\frac{d^3\phi_1}{dx^3}\frac{d\psi_1}{dy} + \\ +2(D_{16}+D_{66})\frac{d^2\phi_1}{dx^2}\frac{d^2\psi_1}{dy^2} + \end{array}\right.}{\int_0^a\int_0^b\left(\begin{array}{l}\frac{\partial^2\phi_1}{\partial x^2}\phi_1\psi_1^2 + \\ +\beta\frac{\partial^2\psi_1}{\partial y^2}\phi_1^2\psi_1\end{array}\right)dxdy} \to \dots$$

$$\dots\to\frac{\left. +4D_{26}\frac{d\phi_1}{dx}\frac{d^3\psi_1}{dy^3} + D_{22}\frac{d^4\phi_1}{dx^4}\psi_1\right]\phi_1\psi_1\,dxdy}{\int_0^a\int_0^b\left(\frac{\partial^2\phi_1}{\partial x^2}\phi_1\psi_1^2 + \beta\frac{\partial^2\psi_1}{\partial y^2}\phi_1^2\psi_1\right)dxdy} \tag{4}$$

$$-P_k^{0\delta} = \frac{\int_0^a\int_0^b\left[\begin{array}{l} D_{11}\frac{d^4\phi_1}{dx^4}\psi_1 + 2(D_{16}+D_{66})\frac{d^2\phi_1}{dx^2}\frac{d^2\psi_1}{dy^2} + \\ +D_{22}\frac{d^4\phi_1}{dx^4}\psi_1\end{array}\right]\phi_1\psi_1\,dxdy}{\int_0^a\int_0^b\left(\frac{\partial^2\phi_1}{\partial x^2}\phi_1\psi_1^2 + \beta\frac{\partial^2\psi_1}{\partial y^2}\phi_1^2\psi_1\right)dxdy} \tag{5}$$

After the introduction of the following designations, it will turn out:

$$\overline{P}_1 = \frac{P_k}{P_\delta}\ ,\ \ \overline{P}_2 = \frac{P_k^0}{P_{k\delta}^0} \tag{6}$$

$$-\overline{P}_1 = 1 + \frac{k\int_0^a\int_0^b\left(\begin{array}{l}1-a_1\overline{x}+\\ +a_2\overline{x}^2\end{array}\right)\phi_1^2\psi_1^2\,dxdy}{\int_0^a\int_0^b\left[\begin{array}{l} D_{11}\frac{d^4\phi_1}{dx^4}\psi_1 + 2D_{16}\frac{d^3\phi_1}{dx^3}\frac{d\psi_1}{dy} + \\ +2(D_{16}+D_{66})\frac{d^2\phi_1}{dx^2}\frac{d^2\psi_1}{dy^2} + \end{array}\right.} \to \dots$$

$$\dots\to\frac{k\int_0^a\int_0^b\left(1-a_1\overline{x}+a_2\overline{x}^2\right)\phi_1^2\psi_1^2\,dxdy}{\left. +4D_{26}\frac{d\phi_1}{dx}\frac{d^3\psi_1}{dy^3} + D_{22}\frac{d^4\phi_1}{dx^4}\psi_1\right]\phi_1\psi_1\,dxdy} \tag{7}$$

$$-\overline{P}_2 = 1 + \frac{k\int_0^a\int_0^b\left(1-a_1\overline{x}+a_2\overline{x}^2\right)\phi_1^2\psi_1^2\,dxdy}{\int_0^a\int_0^b\left[\begin{array}{l} D_{11}\frac{d^4\phi_1}{dx^4}\psi_1 + 2(D_{16}+D_{66})\frac{d^2\phi_1}{dx^2}\cdot \\ \cdot\frac{d^2\psi_1}{dy^2} + D_{22}\frac{d^4\phi_1}{dx^4}\psi_1\end{array}\right]\phi_1\psi_1\,dxdy} \tag{8}$$

For the Winkler base Equations (4) and (5), respectively, will have the following form:

$$-\overline{P}_{1b} = 1 + \frac{k\int_0^a\int_0^b \phi_1^2\psi_1^2\,dxdy}{\int_0^a\int_0^b\left[\begin{array}{l} D_{11}\frac{d^4\phi_1}{dx^4}\psi_1 + 2D_{16}\frac{d^3\phi_1}{dx^3}\frac{d\psi_1}{dy} + \\ +2(D_{16}+D_{66})\frac{d^2\phi_1}{dx^2}\frac{d^2\psi_1}{dy^2} + \end{array}\right.} \to$$

$$\dots\to\frac{k\int_0^a\int_0^b \phi_1^2\psi_1^2\,dxdy}{\left. +4D_{26}\frac{d\phi_1}{dx}\frac{d^3\psi_1}{dy^3} + D_{22}\frac{d^4\phi_1}{dx^4}\psi_1\right]\phi_1\psi_1\,dxdy} \tag{9}$$

$$-\overline{P}_{2b} = 1 + \frac{k\int_0^a\int_0^b \phi_1^2\psi_1^2\,dxdy}{\int_0^a\int_0^b\left[\begin{array}{l} D_{11}\frac{d^4\phi_1}{dx^4}\psi_1 + 2(D_{16}+D_{66})\frac{d^2\phi_1}{dx^2}\cdot \\ \cdot\frac{d^2\psi_1}{dy^2} + D_{22}\frac{d^4\phi_1}{dx^4}\psi_1\end{array}\right]\phi_1\psi_1\,dxdy} \tag{10}$$

3. PROBLEM SOLUTION

Thus, we will look for the solution (1) in the form of a series using the method of orthogonalization of the Bubnov-Galerkin method. For the convenience of analyzing the calculations and numerical calculations, it is convenient to introduce the following notation:

$$\Pi_1 = \frac{d^3 w}{dr^3} + \frac{c_1}{r}\frac{d^2 w}{dr^2} - \frac{c_2}{r^2}\frac{dw}{dr} \tag{11}$$

$$\Pi_2 = \bar{k}(1+\varepsilon\phi(r))w$$

Then, Equation (1) is written as follows:

$$\Pi_1 + \Pi_2 - \bar{q}\frac{d^2 w}{dr^2} = 0 \tag{12}$$

The deflection w is represented in the following form:

$$w = \sum_{i=1}^{n} A_i w_{0i}(r) \tag{13}$$

where, $w_{0i}(r)$ each of them must meet the boundary conditions. For example, the following conditions must be met for the hinge fastening along the entire contour:

$$w_0 = 0\ ,\ \ \frac{d^2 w_0}{dr^2} = 0 \ \text{ at } \ r = R \tag{14}$$

For the case of hard pinching:

$$w_0 = 0\ ,\ \ \frac{dw_0}{dr} = 0 \ \text{ at } \ r = R \tag{15}$$

where, R is the radius of the plate.

Taking into Equations (12) and (13) using the Bubnov-Galerkin orthogonalization method, we can write:

$$\sum_{i=1}^{n} A_i \int_0^R (\Pi_1 + \Pi_2) w_0 r dr - $$
$$-\bar{q}\sum_{i=1}^{n} A_i \int_0^R \left(\frac{d^2 w_0}{dr^2}\right) w_k(r)\, r dr = 0 \quad (k = 1, 2, ...) \tag{16}$$

Equation (15) is a system of linear algebraic equations with respect to variable coefficients A_i. For the existence of a nontrivial solution, the main determinant composed of coefficients c_i must be zero. This equation is relatively $\bar{q}$ an equation of the n is order and finding these roots does not cause much difficulty.

However, especially when solving stability problems by the Bubnov-Galerkin method, they are usually limited to the first approximation. For this case, Equation (16) will take the following form:

$$\int_0^R (\Pi_1 + \Pi_2) w_0 r dr - \bar{q}\int_0^R \frac{d^2 w_0}{dr^2} w_0(r)\, r dr = 0 \tag{17}$$

From here we find:

$$\bar{q} = \frac{1}{\int_0^R \frac{d^2 w_0}{dr^2} w_0\, r dr} \times$$
$$\times\left[\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{c_1}{r}\frac{d^2 w_0}{dr^2} - \frac{c_2}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr + \bar{k}\int_0^R (1+\varepsilon\phi(r)) w_0^2 r dr\right] \tag{18}$$

Without taking into account the resistance of the external environment (18), we get the following form:

$$\bar{q}_1 = \frac{1}{\int_0^R \frac{d^2 w_0}{dr^2} w_0\, r dr} \times \int_0^R \left(\frac{d^2 w_0}{dr^2} + \frac{c_1}{r}\frac{d^2 w_0}{dr^2} - \frac{c_2}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr \tag{19}$$

If the base is linear, then (10) will take the form:

$$\bar{q}_2 = \frac{1}{\int_0^R \frac{d^2 w_0}{dr^2} w_0\, r dr} \times$$
$$\times\left[\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{c_1}{r}\frac{d^2 w_0}{dr^2} - \frac{c_2}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr + \bar{k}\int_0^R w_0^2(r)\, dr\right] \tag{20}$$

If the plate is isotropic and the base is inhomogeneous, from (10) we obtain:

$$\bar{q}_4 = \frac{1}{\int_0^R \frac{d^2 w_0}{dr^2} w_0\, r dr} \times$$
$$\times\left[\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{1}{r}\frac{d^2 w_0}{dr^2} - \frac{1}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr + \right. \tag{21}$$
$$\left. + \bar{k}\int_0^R (1+\varepsilon\phi(r)) w_0 r dr\right]$$

Without the absence of resistance of the external environment, we will have:

$$\bar{q}_5 = \frac{\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{1}{r}\frac{d^2 w_0}{dr^2} - \frac{1}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr}{\int_0^R \frac{d^2 w_0}{dr^2} w_0\, r\, dr} \tag{22}$$

From the above relations we obtain a number of formulas that make numerical analysis quite easy. From Equations (19) and (21), we get:

$$\bar{q}_{11} = \frac{\bar{q}}{\bar{q}_1} = 1 + \bar{k}\frac{\int_0^R (1+\varepsilon\phi\ (r)) w_0^r r dr}{\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{c_1}{r}\frac{d^2 w_0}{dr^2} - \frac{c_2}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr} \tag{23}$$

From the relations (19) and (23) we get:

$$\bar{q}_{41} = \frac{\bar{q}}{\bar{q}_4} =$$
$$= \frac{\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{c_1}{r}\frac{d^2 w_0}{dr^2} - \frac{c_2}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr + \bar{k}\int_0^R (1+\varepsilon\phi(r)) w_0 r dr}{\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{1}{r}\frac{d^2 w_0}{dr^2} - \frac{1}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr + \bar{k}\int_0^R (1+\varepsilon\phi(r)) w_0 r dr} \tag{24}$$

Without resistance:

$$(\bar{q}_{41})_b = \frac{\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{c_1}{r}\frac{d^2 w_0}{dr^2} - \frac{1}{r^2}\right) w_0 r\, dr}{\int_0^R \left(\frac{d^3 w_0}{dr^3} + \frac{1}{r}\frac{d^2 w_0}{dr^2} - \frac{1}{r^2}\frac{dw_0}{dr}\right) w_0 r\, dr} \tag{25}$$

For the case of a hard pinching along the contour, the function w_0 can be taken in the following form:

$$w = \left[1 - \left(\frac{r}{R}\right)^2\right]^2 \tag{26}$$

It is not difficult to make sure that in this case the contour conditions are satisfied:

$$w=0\ ,\ \frac{dw}{dr}=0\ \text{at}\ r=R \tag{27}$$

It is also easy to show that for the case (26), the formula (27) looks like this:

$$(\bar{q}_{1u})_{\delta}=\frac{1+0.384c_2+1.108c_1}{2.592} \tag{28}$$

The ratio of the critical force at will $\phi(r)=\frac{r}{R}$ get the following form:

$$\bar{q}_{11}=1+\bar{k}\frac{\int_0^R(1+\varepsilon\phi(r))w_0^2rdr}{\int_0^R\left(\frac{d^3w_0}{dr^3}+\frac{c_1}{r}\frac{d^2w_0}{dr^2}-\frac{c_2}{r^2}\frac{dw_0}{dr}\right)w_0r\,dr}$$

Revealing the above integrals, we obtain:

$$\bar{q}_{11}=1+\bar{k}(1+\varepsilon)\frac{1}{3.5712+1.371c_2+3.6c_1} \tag{29}$$

At different values ν_1, ν_2, E_1, E_2 and ε values of critical parameters are found. They are presented in the form of tables and graphs. Natural wood with the characteristics is taken as the anisotropic material of the plate:

$E_1=1\times10^5$ kg/cm^2; $E_2=0.0442\times10^5$ kg/cm^2;

$\nu_2=0.01$; $G=0.075\times10^5$ kg/cm^2 and delta wood (tile), which is made from a number of impregnated layers of wood (veneer), with the characteristics:

$E_1=3.05\times10^5$ kg/cm^2; $E_2=0.467\times10^5$ kg/cm^2;

$\nu_2=0.02$; $G=0.22\times10^5$ kg/cm^2.

The calculation results are presented in the form of a graph (Figure 2).

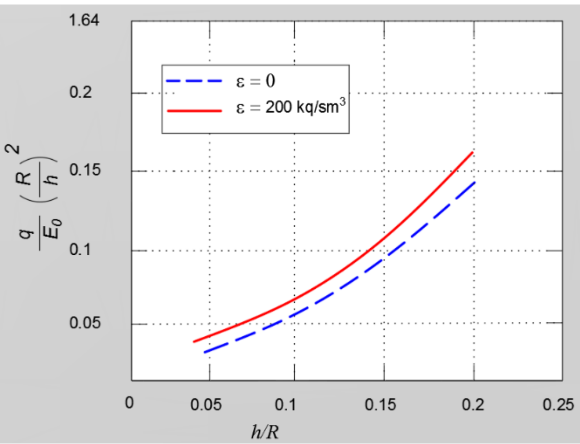

Figure 2. Graph of the dependence of the dimensionless value of the critical load from the geometrical parameters of the plate (h/R)

4. CONCLUSIONS

The problems of stability of inhomogeneous anisotropic round plates are formulated and solved, taking into account various kinds of external forces, the influence of the resistance of the external environment, and a method for their solutions is constructed.

Taking into account the two-constant, inhomogeneous and inhomogeneous viscoelastic modulus, specific formulas for determining the values of critical parameters depending on the parameters of the base and the mechanical properties of inhomogeneous elastic orthotropic plates are found by approximate analytical methods.

For the first time, the problem of stability is solved taking into account the influence of inhomogeneous viscoelastic resistance, when the properties of the material are anisotropic, their elastic characteristics and density are continuous functions of three spatial coordinates. With the use of approximate analytical methods, specific formulas for engineering calculation are obtained.

REFERENCES

[1] S.G. Lehnitsky, "Theory of Anisotropic Plates", Gostekhizdat, p. 445, Moscow, Russia, 1977.

[2] S.G. Lehnitsky, "Theory of Elasticity of an Anisotropic Body", Publishing House of Moscow State University, p. 276, Moscow, Russia, 1976.

[3] V.A. Lomakin, "Theory of Elasticity of Inhomogeneous Bodies", Publishing House of Moscow State University, p. 376, Moscow, Russia, 1976.

[4] M. Huber, "Theoretical and Applied", Publications of the National Bureau of Standards, p. 438, Warsaw, Poland, 1970.

[5] V.L. Sharifov "Stability of a Rectangular Orthotropic Rectangular Plate Lying on an Inhomogeneous Base", Theoretical and Applied Mechanics, No. 2, pp. 96-100, Baku, Azerbaijan, 2006.

[6] V.L. Sharifov, "Stability of Inhomogeneous Anisotropic Plates in an Anisotropically Resistive Medium under Bilateral Compression", Theoretical and Applied Mechanics, No. 1, pp. 85-91, Baku, Azerbaijan, 2013.

[7] S. Jalali, M. Maei, A. Poorsolhjouy, "Buckling of Circular Sandwich Plates of Variable Core Thickness and FGM Face Sheets" Structural Stability and Dynamics, Vol. 11, No. 2, pp. 273-295, 2011.

[8] A.A. Ghorbanpour, Sh. Maghamikia, M. Mohammadimehr, "Buckling Analysis of Laminated Composite Rectangular Plates Reinforced by SWCNTs Using Analytical and finite Element Methods", Mechanical Science and Technology, Vol. 25, No. 3, pp. 809-820, 2011.

[9] R.A. Iskanderov, J.M. Tabatabaei, "Vibrations of Fluid-Filled Inhomogeneous Cylindrical Shells Strengthened with Lateral Ribs", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 42, Vol. 12, No. 1, pp. 121-125, March 2020.

[10] J.M. Tabatabaei, "Investigation of Oscillatory Motion of Inhomogeneous Longitudinally Reinforced Cylindrical Shells with a Visco-Elastic Medium", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 53, Vol. 14, No. 4, pp. 182-188, December 2022.

[11] B.A. Zhemochkin, A.P. Sinitsyn, "Practical Methods of Calculation of Foundation Beams and Plates on an Elastic Base", Stroyizdat, p. 293, Moscow, Russia, 1962.

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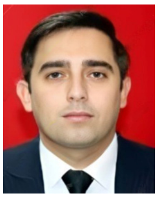

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