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Innovative Educational Technologies In Teaching Theoretical Mechanics In Technical Areas Of Higher Educational Institutions

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Annotation: The article discusses the content, quantity and quality of education in technical universities, educational programs, technological reform, factors that determine the quality and effectiveness of training, as well as their improvement. The deformations of the tooth of the proposed sampling drum are analyzed. The dynamic pressure on the supports of the sampling drum is determined. when it rotates. The forces acting on the sampling drum in the sampling zone of the spinning machines are analyzed as far as possible. A graph of the dependence of the dynamic modulus of elasticity E on the displacement (settlement) Δ of the end of the rubber of the rubber part of the sampling drum from the unstressed state is plotted.

Keywords: motivation, discomfort, dedication, skills, competencies, art, algorithm, acceleration, inertia, pressure, rotation, support, active forces, centrifugal moments, gravity, resistance, friction.

Introductions. Research on the use of electronic learning tools and the creation of open e-learning resources in a number of leading universities in the world and the use of virtual learning technologies, interactive software, visual models, multimedia e-learning resources, the formation of professional In the competence of future engineers, the main emphasis is on conducting. Elimination of dynamic pressure in teaching theoretical mechanics is of particular importance in modern technology. It should also be noted that the main working elements of industrial machines rotate around a fixed axis at a high speed. Psychologists say that in learning, motive is 2.5-3 times more important than intelligence. In theory, motivation is the motivation of a person to commit conscious or unconscious actions, the ability to actively satisfy their needs, to achieve a set goal. In fact, this is perseverance and dedication, without which no goal can be achieved. How to motivate a student to study, if he does not want to study, does not complete his homework, is often distracted in the classroom, he is not worried about academic performance? When a group of students associates him with psychological discomfort, anxiety, boredom, no stimulus will help. There can be several reasons for the lack of motivation.

Technical skills are special skills that characterize possession: a high level of theoretical and practical training in technical sciences; scientific worldview and physical picture of the world;

methodology and technique for conducting a technical experiment; research and project organization methodology. Education is a systemic process aimed at providing students with deep theoretical knowledge, skills and practical skills, as well as at the formation of general educational and professional knowledge, skills and abilities, and the development of abilities;

The teaching method - in pedagogy is a combination of ways, ways of achieving didactic goals, solving educational problems, the teacher's art to direct the students' thoughts in the right direction and the system followed by the algorithm to achieve the desired result. The problem of eliminating dynamic pressures plays an important role in modern technology, since in the designs of machines, motors and production machines, there is usually a part (or a unit of parts) that rotates with a high angular velocity around a fixed axis. The angular velocity of the sampling drum of rotor spinning machines is in the range of 5000 ÷ 20,000 revolutions per minute. Pay particular attention to the fact that when the sampling drum rotates around a fixed axis, dynamic pressures arise on the sampling drum support. The proposed discretizing drum of a rotor spinning machine, containing a cylinder, on the surface of which a serrated gear set is rigidly attached, characterized in that on the surface of the cylinder there are through longitudinal prismatic grooves of a trapezoidal cross section, in which identical in shape prismatic component parts are installed, including an outer plate connected with an inner plate by means of elastic rubber gaskets, fastened together with glue, while serrated teeth and needles alternating in a row are rigidly attached to the outer plate, and each prismatic component has four rows of serrated teeth and needles [1]. This problem can be solved by the method kinetostatics, Mobility paths of the x y z axis are linked by a sampling drum.

Main part:

For accuracy, we solve problems in the following order:

1. Select the movable axes x, y, z associated with the rotating sampling drum, directing the z axis along the axis of rotation. For accuracy, let's say the center of gravity C lies on the axis of rotation of the sampling drum, then it is convenient to combine the origin of coordinates O with the center of gravity C;

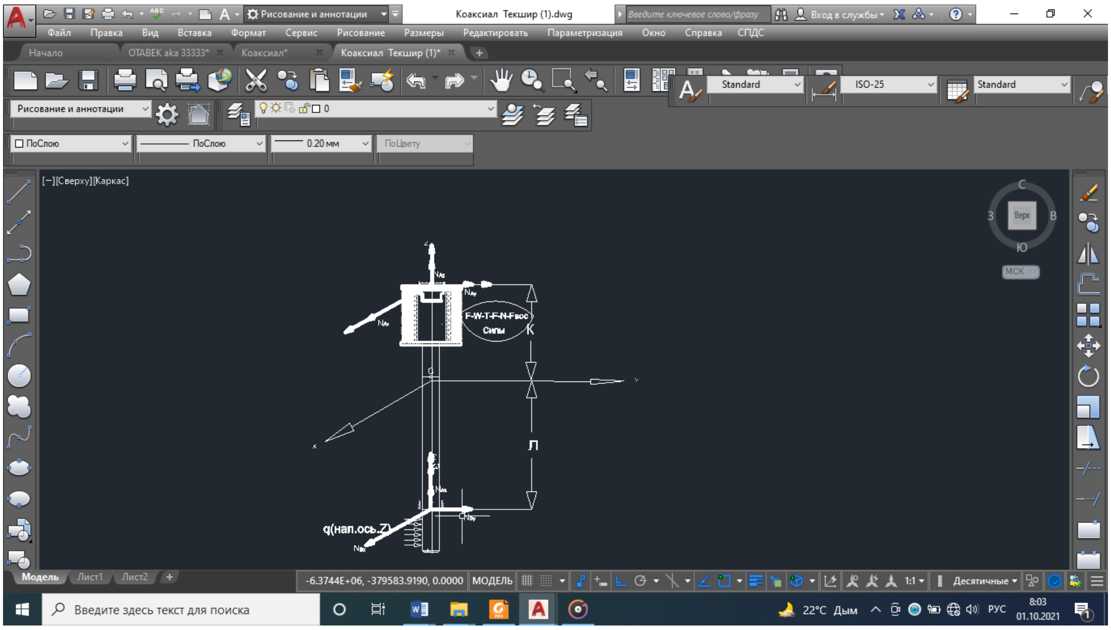
2. Let us depict in the figure a system of active forces acting on the sampling drum,

3. We calculate the coordinates of the center of gravity C of the sampling drum x_c, y_c

4. Let us calculate the centrifugal moments of inertia of the sampling drum I_{xz}, I_{yz}.

Let us compose a system of equations depending on the completeness of the pressure on the supports.

When the sampling drum rotates around a fixed axis, dynamic pressures arise on the drum supports. (fig. 1.)



Pic. 1. Dynamic pressures on sampling drum supports.

The essence of sampling is the decoupling of fibers. And the calculation of small and tenacious impurities and fiber defects, as well as in the main orientation of the fibers along the direction of motion of the spinning chambers. For the correct solution of problems, an increased qualitative sampling of rotor spinning machines and an improvement in the quality of the fleece, it is necessary, in the main, to study in detail the forces acting on the fibrous tape during the sampling process [2].

The following forces act on the fibrous tape during sampling (see Fig. 2): F-centrifugal force; W-air resistance; N is the normal pressure per fiber of the sampling drum by its twist angle: T is the friction force, P is the carding force, F_ (re-) restoring force (elastic force).

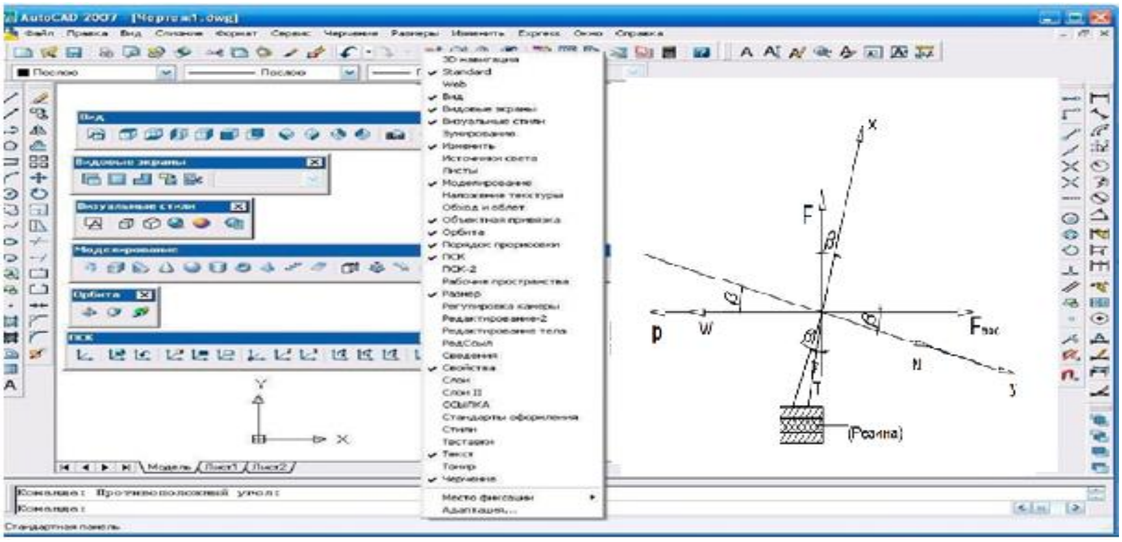
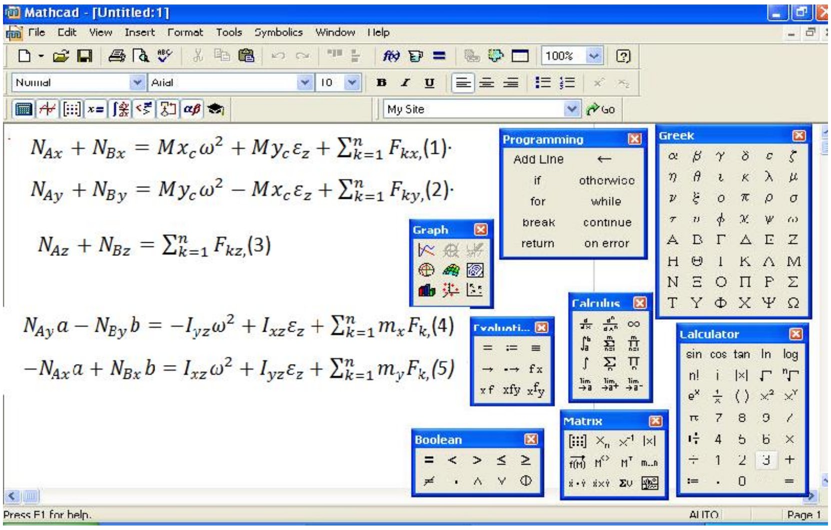


Fig. 2. The forces acting on the fibers are captured by the tooth sampling drum

The values of the components of the total pressures, equal to the sums of the corresponding static and dynamic pressures, are determined from the system of equations [3] : See Figure 1 for an accurate representation.



$N_{Ax}, N_{Ay}, N_{Az}, N_{Bx}, N_{By}, N_{Bz}$-where the components of the pressure on the supports are equal to the sums of the corresponding static and dynamic pressures. I_{xz}, I_{yz} − drum, ε is the angular acceleration of the sampling drum, a, b is the distance from the supports A, B to the origin of coordinates O; $C(x_c, y_c, z_c)$ − is the center of gravity of the sampling drum, $F_1, F_2, \ldots \ldots \ldots \ldots . F_n$ − are the active forces acting on the sampling drum. After that, we determine the required values.

барабанчика,M − масса дискретизирующего барабанчика, ω − угловая скорость дискретизирующего барабанчика,ε − угловое ускорение дискретизирующего барабанчика,a, b −растояния от опор А, В до начала координат О ; $C(x_c, y_c, z_c)$ −центр тяжести дискретизирующего барабанчика, $F_1, F_2, \ldots \ldots \ldots \ldots . F_n$ − активные силы действующего на дискретизирующего барабанчика. После этого определяем искомые величины. The center of gravity C of the sampling drum lies on the z-axis, hence

$$x_c = y_c = 0 \quad (6)$$

Since the sampling drum rotates evenly

$$\varepsilon = 0 \quad (7)$$

Since the axis of gain z is perpendicular to the plane of material symmetry of the sampling drum, it is the main axis of inertia at the point 0 (see figure) of intersection with this plane. Consequently, the centrifugal moments of inertia of the sampling drum are

$$I_{xz} = I_{yz} = 0 \qquad (8)$$

We will assume that all forces are applied at the point of interaction of the fiber with the tooth of the sampling drum. Support B of the sampling drum is made in the form of a cylindrical bearing (for clarification, it has a bearing), then

$$N_{Bz} = 0, (9)$$

$$N_{Az} = \sum_{k=1}^{n} F_{kz,}(10)$$

The principal moments of inertia of the sampling drum vanishes because $I_{xz} = I_{yz} = 0$, because the axis of rotation z is the principal axis of inertia at point 0. Discussing this blur, the moments of inertia of the sampling drum

$$m_x = m_y = 0 \quad (11)$$

Taking into account formulas (7), (8), (11), we write the components of the total pressures

$$\mathrm{N_{Ax}} + \mathrm{N_{Bx}} = \mathrm{F}\cos\beta - \mathrm{T} - \mathrm{P}\sin\beta - \mathrm{W}\sin\beta + \mathrm{F}_{\text{вос}}\sin\beta \quad (12)$$

$$\mathrm{N_{Ay}} + \mathrm{N_{By}} = -\mathrm{F}\sin\beta - \mathrm{P}\cos\beta - \mathrm{W}\cos\beta + \mathrm{N} + \mathrm{F}_{\text{вос}}\cos\beta \quad \mathbf{(13)}$$

$$\mathrm{N_{Az}} + \mathrm{N_{Bz}} = \mathrm{q} \cdot \mathrm{l} \quad (14)$$

$$N_{Ay}a - N_{By}b = 0 \qquad (15)$$

$$-N_{Ax}a + N_{Bx}b = 0 \quad (16)$$

From equation (15) we find:

$$N_{Ay} = N_{By}\frac{b}{a} \quad \mathit{(17)}$$

and from (16) we have:

$$N_{Ax} = N_{Bx}\frac{b}{a} \quad (18)$$

After substituting the values of from formulas (18) into equation (12) and values of from formula (17) into equation (13), we obtain:

$$N_{Bx}\frac{b}{a} + \mathrm{N_{Bx}} = \mathrm{F}\cos\beta - \mathrm{T} - \mathrm{P}\sin\beta - \mathrm{W}\sin\beta + \mathrm{F}_{\text{вос}}\sin\beta \quad (19)$$

$$N_{By}\frac{b}{a} + \mathrm{N_{By}} = -\mathrm{F}\sin\beta - \mathrm{P}\cos\beta - \mathrm{W}\cos\beta + \mathrm{N} + \mathrm{F}_{\text{вос}}\cos\beta \quad (20)$$

Knowing conditions (9), we write (10) in the form

$$\mathrm{N_{Az}} = q_{\text{рав.расп}} \cdot \mathrm{l} \quad (21)$$

$$N_{Bx} = \frac{\mathrm{F}\cos\beta\mathrm{a} - \mathrm{Ta} - \mathrm{P}\sin\beta\mathrm{a} - \mathrm{W}\sin\beta\mathrm{a} + \mathrm{F}_{\text{вос}}\sin\beta\mathrm{a}}{b+a} \quad (22)$$

$$N_{By} = \frac{-\mathrm{F}\sin\beta\mathrm{a} - \mathrm{P}\cos\beta\mathrm{a} - \mathrm{W}\cos\beta\mathrm{a} + \mathrm{Na} + \mathrm{F}_{\text{вос}}\cos\beta\mathrm{a}}{b+a} \quad (23)$$

$$\mathrm{N_{Ax}} = \frac{-\mathrm{F}\cos\beta\mathrm{b} + \mathrm{Tb} + \mathrm{P}\sin\beta\mathrm{b} + \mathrm{W}\sin\beta\mathrm{b} - \mathrm{F}_{\text{вос}}\sin\beta\mathrm{b}}{b+a} \quad (24)$$

$$\mathrm{N_{Ay}} = \frac{-\mathrm{F}\sin\beta\mathrm{b} - \mathrm{P}\cos\beta\mathrm{b} - \mathrm{W}\cos\beta\mathrm{b} + \mathrm{Nb} + \mathrm{F}_{\text{вос}}\cos\beta\mathrm{b}}{b+a} \quad (25)$$

For clarification, let us write how the forces acting on the sampling drum are determined:

$$F = \frac{Gr^2n^2\pi^2}{qr30^2} \qquad \mathit{(26)}$$

The air resistance force is

$$W = -\frac{C_{O.K.} f v^2 \rho}{2} r \cdot (27)$$

$$N = \frac{T}{\mu} r \cdot \qquad (28)$$

The carding force of the sampling drum can be determined depending on the torque

$$P = \frac{2T_{дв} \cdot 10^3}{d_{д.б.}} \qquad (29)$$

where $P_{дв} = 0{,}25$ kW is the motor power directly holding the sampling drum, $n_{ном} = 7000 - 9000$ rpm is the rated motor speed.

Straight-holding motor torque of sampling drum

$$T_{дв} = \frac{P_{дв}}{\omega_{ном}} = \frac{P_{дв} \cdot 30}{\pi \cdot n_{ном}} \qquad (30)$$

After that, we attach formulas (30), (29) and obtain

$$P = \frac{P_{дв} \cdot 60 \cdot 10^3}{\pi \cdot n_{ном} \cdot d_{д.б.}} (31)$$

The restoring force of the rubber part of the sampling drum is determined from the formulas

$$F_{вос} = -c\Delta \qquad (32)$$

For the accuracy [5] of determining the linearized stiffness of the elastic bond between the main tooth of the sampling drum and its rubber layer, a theoretical analysis is applied. Because here the rubber layer of the drum gets shear, compression and torsion. It is more difficult to determine the accuracy of the linearized stiffness of the elastic ligament. Observing scientific experiments, we accept the definition of the dynamic parameters of rubber-metal parts taking into account the nonlinear dependence of the elastic restoring force during deformation [5].

$$c = \frac{G F_{п.п.сеч.}}{h} (33)$$

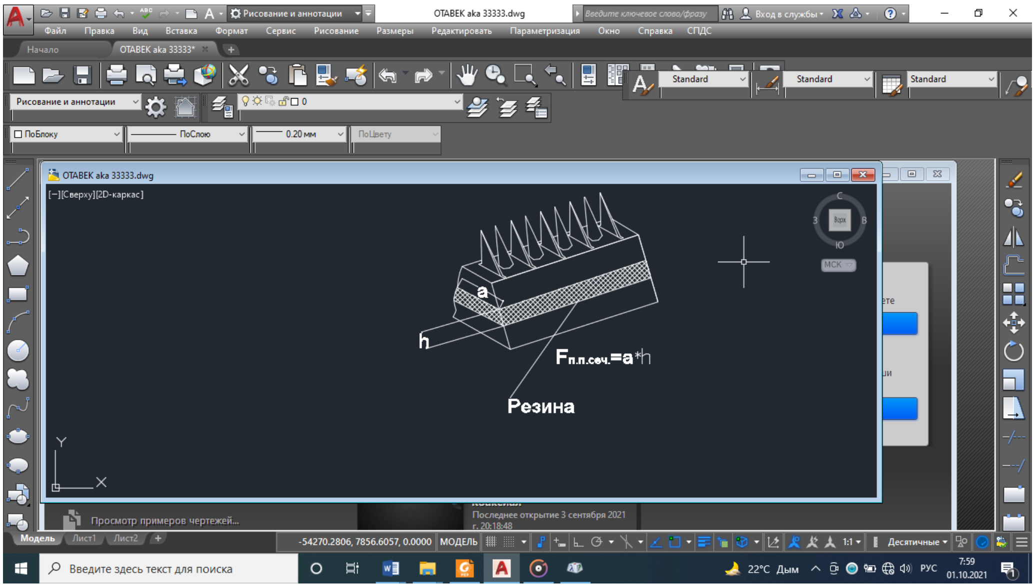
$G -$ linearized by the dynamic modulus of elasticity of rubber $-$ metal parts and it is equal to

$$G = 0.4\,E \qquad (34)$$

After this equation (33) has the form

$$c = \frac{G F_{п.п.сеч.}}{h} = \frac{0.4\,E \cdot F_{п.п.сеч.}}{h} (35)$$

For accurate imagery, $F_{п.п.сеч.}$ and h are shown in Figure 3.



Pic. 3. Separated cogged part of sampling drum.

To remove doubts, we will give another option to find the c-coefficient of elasticity (stiffness coefficient) as we look at it as a truncated pyramid, and find it from the formulas. For this, consider the definition of the elastic characteristics of rubber parts that have a shape that differs from cylindrical and it is shown in Fig. 4.

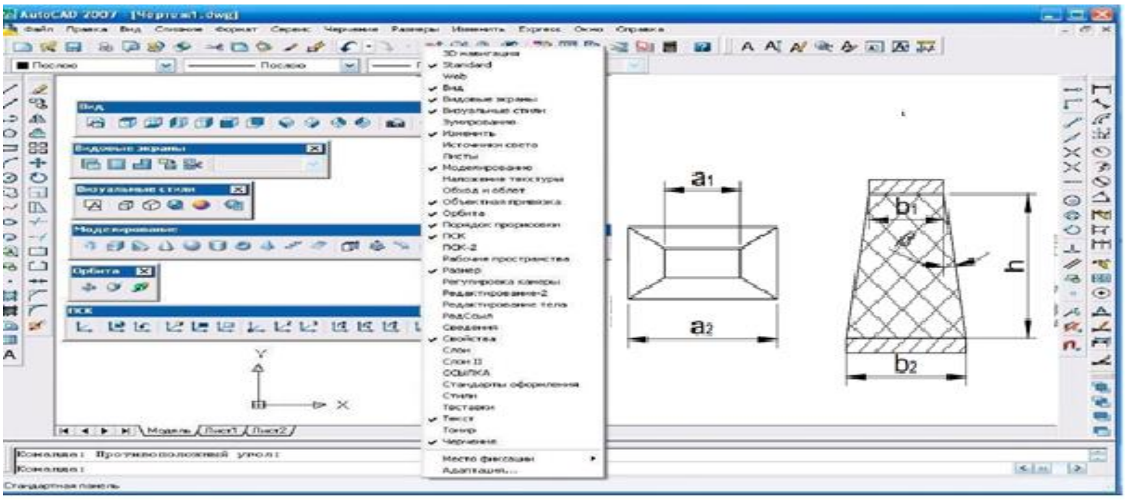


Fig 4. Scheme for the calculation of rubber-metal parts such as a truncated pyramid.

$$c = \frac{(a_1 b_2 - a_2 b_1)E}{h ln \frac{a_1 b_2}{a_2 b_1}} \qquad (36)$$

in the case of small deformations, the load is related to the deformation by the following approximate formula:

$$P_{\text{нар.сила}} = E \cdot F_{\text{п.п.сеч.}} \cdot \varepsilon (37)$$

The linear dependence ε between the specific load and deformation in our case is within

$$\varepsilon = 0.3 \div 0.4 (38)$$

Table 1 shows the basic designations of values, functions, parameters, coefficients and their numerical values characterizing the proposed sampling drum.

Table 1.

№	*Basic notation*	*Functions and parameter*	*Numerical values*
1	$N_{Ax-1-2-3-4}$	Coordinate-dependent dynamic support pressure Ax	185H ÷ 196H ÷ 164H ÷ 198H Pressure directions against the X-axis
2	$N_{Ay-1-2-3-4}$	Coordinate-dependent dynamic support pressure Ay	272H ÷ 252H ÷ 141H ÷ 128H Pressure directions against the Y axis
4	$N_{Bx-1-2-3-4}$	Coordinate-dependent dynamic support pressure Bx	$\mathbf{92}$H ÷ $\mathbf{114}$H ÷ $\mathbf{80}$H ÷ $\mathbf{98}$H – Pressure directions against the X-axis
5	$N_{By-1-2-3-4}$	Coordinate-dependent dynamic support pressure By	135 H ÷ 70H ÷ 140H ÷ 77H Pressure directions against the Y axis
6	N_{Bz}	Coordinate-dependent dynamic support pressure Bz	$\mathbf{15}$H
7	$\boldsymbol{F}$	Centrifugal force	1.5H
8	$\boldsymbol{W}$	Air resistance per fiber	$\mathbf{0,0000001}$H ·
9	$\boldsymbol{N_1}$	The normal pressure per fiber of the sampling drum is its twist angle:	$\mathbf{197.4H}$
	$\boldsymbol{N_2}$	The normal pressure per fiber of the sampling drum is its twist angle:	$\mathbf{249.4H}$
10	$\boldsymbol{T_1}$	Friction forces	$\mathbf{59.2H}$
	$\boldsymbol{T_2}$	Friction forces	$\mathbf{74.8H}$
11	$\boldsymbol{\beta_1}$	Sampling Drum Tooth Angle	$\mathbf{20^0}$
	$\boldsymbol{\beta_2}$	Sampling Drum Tooth Angle	$\mathbf{27^0}$
12	$\mathrm{F_{вос-1}}$	Restoring force (elastic force)	308H
	$\mathrm{F_{вос-2}}$	Restoring force (elastic force)	460H
14	n	Sample Drum RPM.	7000
15	q	Acceleration of gravity	9,81
16	*E*	Longitudinal modulus based on sampling drum tooth.	$\mathbf{40}$
17	G	Fiber gravity	$5{,}1 \cdot 10^{-8}$
18	r	sampling drum radius.	32
19	$\mathrm{C}_{O.K.}$	Coefficient depending on the shape of the body and the Reynolds number,	1.0 ÷ 5.1

20	f	Fiber area perpendicular to air flow	$54 \cdot 10^{-9}$
21	v	Air velocity relative to the fiber	1,3
22	ρ	Air density	1,25
23	μ	Coefficient of friction of fiber (cotton, viscose, rong, kimiyevium) on steel	$0.2 \div 0.36$
25	P	The carding force of the sampling drum can be determined depending on the torque	**950** Н
26	$P_{дв}$	Motor power straight holding sampling drum	0,25
27	$F_{вос}$	Revitalizing Power Of Rubber Part Of Sampling Drum	$308 \div 460$
28	c	Elastic Coefficient (Stiffness Coefficient)	384
	c_1	Coaxial Torsion Coefficient	**590000**
29	Δ	Rubber end displacements of the rubber part of the sampling drum.	$0.8 \div 1.2$
30	G	Linearized by the dynamic modulus of elasticity of rubber-metal parts	16
31	$F_{п.п.сеч.}$	Cross-sectional area of the rubber elements of the sampling drum.	72
32	h	Height of the rubber elements of the sampling drum.	8
33	ε	Linear relationship between the specific load and deformation in our case within the limits	$0.3 \div 0.4$

Figure 5 shows the test results depending on the dynamic modulus of elasticity E on the displacement (settlement) Δ of the rubber end of the rubber part of the sampling drum from the unstressed state.

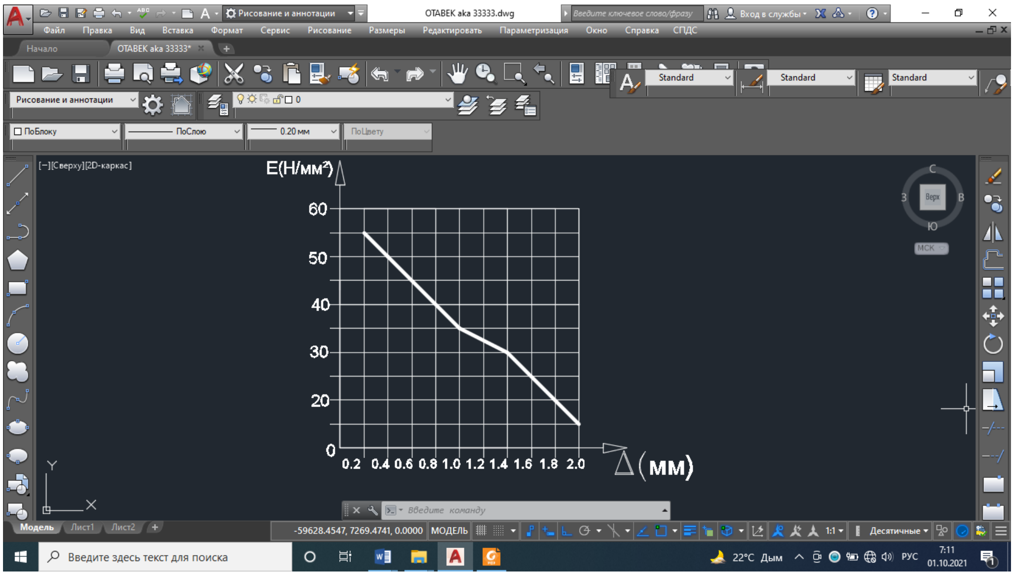


***Fig. 5.** Dependence of the dynamic modulus of elasticity E on the displacement (settlement) Δ of the rubber end of the rubber part of the sampling drum from the unstressed state.*

Conclusion: Rotor spinning machines have a minimum of 240 spinning boxes. The use of a sampling drum saw (s) with an elastic base reduces the pressure of the rotating drum on the axis of rotation. Together with these processes, it should be especially noted that the vibration coefficient is reduced in spinning machines. From these points of view, the quality indicators of the yarn obtained and the service life of the working body of rotor spinning machines increase.

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