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CALCULATIING OPTIMAL PARAMETERSOF THE FOUNDATION FOR WOODWORKING MACHINES WITH HIGH DYNAMIC LOADS

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The groundwork for machines with dynamic loads should meet the calculation requirements regarding strength and suitability for regular operation and the need for occupational safety standards regarding acceptable vibration levels. In addition, fluctuations in the groundwork should not cause a harmful impact on technological processes, equipment, and devices located on the foundation or outside it.A mathematical model of foundation vibrations and a methodology for calculating the foundation parameters are presented, taking into account dynamic loads from unbalanced masses and dynamic characteristics of the ground base.The mathematical model is a solution to the differential equation of the foundation vibrations.The article refutes a number of conventional concepts regarding the body of the foundation, its base, the geometric center and the damper between the foundation and the ground.The basis for determining the vibration damping modulus is the logarithmic decrement of vibration damping.It is constant and depends on the elastic and damping properties of the soil, as well as the installation mass. The more significant the logarithmic decrement, the faster the extinction occurs.It was found that an increase in the vibration resistance coefficient allows reducing the mass of the installation with a simultaneous increase in the area of its base, so the mass acts as a limitation.It was established that to ensure vibration resistance and prevent the resonance of the foundation, the ratio of the frequency of its natural vibrations to the frequency of forced vibrations should be at least 1.5. The calculation of the optimal mass, the base area and the depth of foundation laying is carried out according to the criterion of the minimum cost of its construction.An application softwarehas beendeveloped for the calculation. The projection methodology for the foundation for the machine with large dynamic loads is for a two-story sawmill.

Key words: model, ground, differential equation, resonance, logarithmic decrement, optimization criterion, prime cost, application software.

Introduction. A foundation is a structure designed to install a machine on it, which ensures its correct orientation in space during operation. Choosing the type, weight (mass), and size of the foundation for the machine is an important point during installation.The design of the foundation governs its cost, the degree of vibration, the machine wear, product quality, etc.Today, simplified methods are used to calculate foundations without taking into account the characteristics of the ground base, dynamic loads, and the impact on other equipment and buildings.This is especially important for woodworking machines with high dynamic loads: frame saws, shredders, chippers,screens, sieves.

Analysis of publications. A number of works deal with the study of the design of foundations for machines [1, 2, 3], in which it is shown that not only the solution, but also the formulation of the problem of foundation vibrations for machines has significant difficulties. N.P. Pavlyuk and E. Raush [1] significantly simplified this task. They proposed to consider the bodies of the machine and the foundation as absolutely rigid, and the mass of the base equal to zero. This made it possible to consider this problem as a vibration of a rigid body on an elastic base. In the works of A.A. Sannikov [2, 3], the problem is considered as vibrations of a rigid body on a viscoelastic base.

The following requirements are imposed on the foundation: strength and resistance against overturning; no subsidence of the ground; the impossibility of occurrence of vibrations; the inadmissibility of transmitting vibrations to other machines, structures and buildings.

Purpose of the paper. Development of theoretical provisions, calculation methods and practical recommendations for the construction of a foundation for woodworking machines with large dynamic loads as in the case of a frame saw.

Research results. For machines with high dynamic loads, the calculation of the foundation must be carried out for vibrations.

To simplify the problem, a number of assumptions were made:

1. The bodies of the foundation and the machine are absolutely rigid.
2. The base (ground) has no mass.
3. The entire mass of the installation is concentrated at one point – the geometric center of the foundation.
4. Between the foundation and the base there are springs and a very viscous liquid that serve as a damper (muffler).

The design physical model of the installation can be presented as a rigid body mounted on a viscoelastic base (Fig. 1).

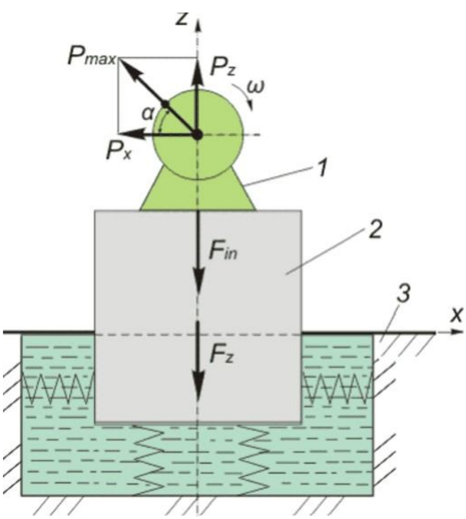

Fig. 1. Physical model of the foundation:
1 - foundation; 2 - machine; 3 - ground

To compose the differential equation of foundation vibrations, the forces acting on the system according to d'Alembert's principleare considered. The external exciting force P_{max} most often arises from unbalanced masses in the machine or from technological cutting forces (frame saws, compressors, bark edgers, etc.).

In most machines, the unbalanced mass has a rotational motion. In this case, when the force P_{max} is projected onto the z-axis, the force P_z changes according to a sinusoidal law, and when P_{max}

is projected onto the x-axis, the force P_x changes according to a cosine law

$$P_z = P_{\max} \cdot \sin\alpha; \; P_x = P_{\max} \cdot \cos\alpha,$$

where α–the angle of rotation of the crank; $\alpha = \omega \cdot t$; $\omega = \frac{\pi \cdot n}{30}$; ω – angular speed of the crank; t – time.

The exciting force P_z causes the inertia force P_{in} and the elastic force $P_{жс}$, these two forces vary, depending on the force P_z, and balance it

$$F_{in} + F_{жс} = P_{\max} \cdot \sin\omega t.$$

Inertia force

$$F_{in} = M \cdot a = M \cdot \frac{d^2 z}{dt^2},$$

where M – the mass of the installation which includes the mass of the foundation and the machine; z – the pathtraveled by the system in the direction of the z-axis.

The weight forces of the foundation and the machine are balanced by the reactions of the base and are not taken into account. The relationship between the movement of the foundation base and the elastic force, taking into account the absorbing energy of the ground (damping), is determinedby the formula

$$F_{жс} = k_z \cdot \Phi_z \cdot \frac{dz}{dt} + k_z \cdot z, \tag{1}$$

where k_z – the ground stiffness; Φ_z – a constant damping coefficient (modulus of vibration damping), Φ_z = 0.001...0.1 s.

Ground stiffness

$$k_z = C_z \cdot F_o, \tag{2}$$

where C_z – the coefficient of elastic uniform compression of the ground (N/m^3); F_o – the area of the foundation base (m^2).

After substitutions and division by M we obtain the differential equation

$$\frac{d^2 z}{dt^2} + \frac{k_z \cdot \Phi_z}{M} \cdot \frac{dz}{dt} + \frac{k_z}{M} \cdot z = \frac{P_{\max}}{M} \cdot \sin\omega t. \tag{3}$$

This equation is called the differential equation of foundation vibrations. Equation (3) is an inhomogeneous linear second-order equation with constant coefficients. The solution to a differential equation of this kind is soughtby a well-known mathematical theorem in the form

$$z = z_1 + z_2,$$

where z_1 – the general solution to a homogeneous differential equation

$$z_1 = A_1 \cdot e^{-\alpha \cdot t} \cdot \sin(\beta \cdot t + \overline{\varphi}_0), \tag{4}$$

where $\alpha = \frac{-k_z \cdot \Phi_z}{2 \cdot M}$ – this is a simple (single-valued) root of the characteristic equation;

z_2 – a particular solution to an inhomogeneous differential equation

$$z_2 = \frac{P_{\max} \cdot \sin(\omega \cdot t + \varphi_0^*)}{M \cdot \sqrt{\left(\frac{k_z}{M} - \omega^2\right)^2 + \left(\frac{k_z \cdot \Phi_z}{M}\right)^2 \cdot \omega^2}}, \quad (5)$$

where $A_1 e^{-\frac{k_z \cdot \Phi_z}{2 \cdot M} t}$ – acomplex amplitude $\overline{A}_1$, at t=0, the value of $\overline{A}_1 = A_1$; β – frequency of natural vibrations of the installation, $\beta = \frac{2\pi}{\overline{T}}$, $\overline{T}$ – period of natural vibrations; $\overline{\varphi}_0$ – initial phase of natural vibrations; φ_0^* – initial phase of forced vibrations.

Frequency of natural vibrations:

$$\beta = \sqrt{\frac{k_z}{M} - \left(\frac{k_z \cdot \Phi_z}{2 \cdot M}\right)^2}. \quad (6)$$

For $\Phi_z = 0$:

$$\beta = \sqrt{\frac{k}{M}} = \lambda, \quad (7)$$

where λ –thefrequency of free vibrations of an elastic system without a damper.

Based on the results of solving the differential equation of foundation vibrations, graphs are constructed: for natural vibrations in the Z_1–t system; forced vibrations in the Z_2–t system; overall vibrations in the $Z - t$ system.

The analysis of the differential equation of foundation vibrations consists in determining the decrement of vibration damping and the coefficient of vibration resistance. The decrement of vibration damping is the ratio of the absolute values of two adjacent amplitudes through a half-period of natural vibrations (Fig. 2). It indicates the magnitude of the amplitude decay of natural vibrations over half a period. If we consider the equations of natural vibrations of the foundation (4), then z_1 takes its maximum values at the points when $\sin(\beta \cdot t + \varphi_0) = 1$. The first amplitude A_1 will be at the point t_1, and the second amplitude A_2 - at the point $t = t_1 + T_1/2$

$$D = \frac{|A_2|}{|A_1|} = \frac{A \cdot e^{-\alpha(t_1 + T_1/2)}}{A \cdot e^{-\alpha \cdot t_1}} = e^{-\frac{k_z \cdot \Phi_z \cdot T_1}{4 \cdot M}}, \quad (8)$$

where e – the base of natural logarithms.

In practice, it is convenient to use the logarithmic decrement which is obtained by taking the logarithm of (8)

$$\ln D = \ln\left|\frac{A_2}{A_1}\right| = -\frac{k_z \cdot \Phi_z \cdot T_1}{4 \cdot M}.$$

Hence we define the modulus of vibration damping [4]

$$\Phi_z = -\frac{4 \cdot M \cdot \ln D}{k_z \cdot T_1}. \quad (9)$$

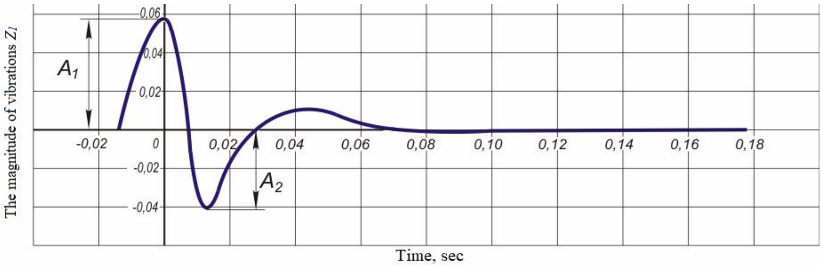

Fig. 2. Curve of the foundation's natural damping vibrations

The logarithmic decrement of vibration damping is a constant value and depends on the elastic and damping properties of the ground, as well as on the mass of the installation. The larger the logarithmic decrement, the faster the damping.It is important to note that with an increase in the mass of the foundation, the damping decrement decreases, and an increase in the area of the foundation base leads to its growth.

A detailed study in equation (5) of the dependence of the amplitude of forced vibrations on the frequency ω for different values of λ and Φ_z shows that if $\sin(\omega \cdot t + \varphi_0^*) = 1$, then z_2 is the amplitude of forced vibrations.

Previously (7) it was shown that $\sqrt{k/M} = \lambda$, $\lambda^2 = k/M$.

Denote $\omega/\lambda = \psi$, $\omega = \psi\,\lambda$.

Then the formula for the amplitude of vibrations is written in the form:

$$A = \frac{P_{\max}}{M\sqrt{(\lambda^2 - \omega^2)^2 + \lambda^4 \Phi_z^2 \omega^2}} \tag{10}$$

or

$$A = \frac{P_{\max}}{M\,\lambda^2 \sqrt{(1-\psi^2)^2 + \Phi_z^2\,\lambda^2\,\psi^2}} . \tag{11}$$

By accepting $P_{\max}/M = 1$, $\lambda = 1$, we construct the dependence $A = f(\psi)$ (Fig. 3). Fig. 3 shows that at different values of the vibration damping modulus Φ_z, the resonance curves increase sharply in the range from ψ = 0.75 to ψ= 1.25. This means that at small values in this range, the amplitude of forced vibrations increases to infinity and the phenomenon of resonance occurs. An important conclusion of practical importance follows from this:the frequency of natural vibrations of the foundation λ should be 1.5-3 times greater than the frequency of forced vibrations ω.

Foundations are designed in the following sequence:

- draw up a design model;
- determine the forces that excite vibrations;
- determine the mass of the foundation and the area of its base;
- select the dimensions of the foundation;
- perform checks for static and dynamic loads.

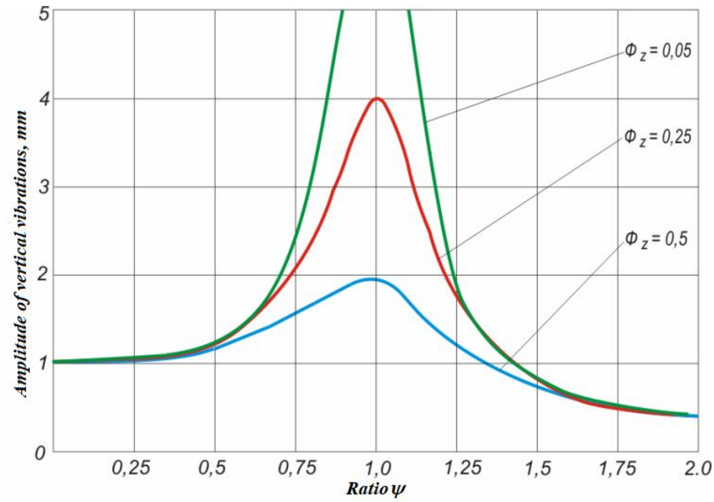

Fig. 3. Dependence of the amplitude of forced vibrations on the ratio ψ =ω/λ

1. Determination of forces that excite vibrations

The method of designing the foundation for a machine with large dynamic loads will be considered using the example of a frame saw. The design model of the installation is shown in Fig. 4, where a complex shape of the foundation is adopted:the upper part is in the form of an obelisk, the lower part is in the form of a plate. The design model shows the forces acting on the foundation during the operation of the frame saw.

Projection of the force $P_{\max}$ on the vertical axis

$$P_z = R\omega^2 \cdot \cos\ \omega t\sqrt{m_1^2 + m_2^2}\ , \tag{12}$$

where

$$m_1 = m_{n.p.} + m_{ш} + m_{в}\frac{\rho_1}{R};\quad m_2 = \frac{e}{L}\left(m_{n.p.} + m_{ш}\frac{L_c}{L}\right).$$

The force P_z reaches its maximum value at $\cos\omega t = 1$.

Projection of the force $P_{\max}$ on the horizontal axis

$$P_x = R\omega^2 \cdot \sin\omega t\left[m_{в}\frac{\rho_1}{R} - m_{ш}\left(1 - \frac{L_c}{L}\right)\right], \tag{13}$$

where R – the crank radius, $R = H/2$; H - the saw frame travel; $\omega = \frac{\pi n}{30}$ is angular speed of the crankshaft; n – crankshaft rotational speed; e – the value of the dizaxial (Fig. 5); $m_{в}$ – unbalanced mass of the crankshaft together with the flywheels; ρ_1 – thedistance from the rotation axis to the center of unbalanced mass of the crankshaft; m_{np} – the mass of the saw frame; $m_{ш}$ –

the connecting rod mass; L – the connecting rod length; L_c –the distance from the axis of the lower connecting rod head to the center of its mass.

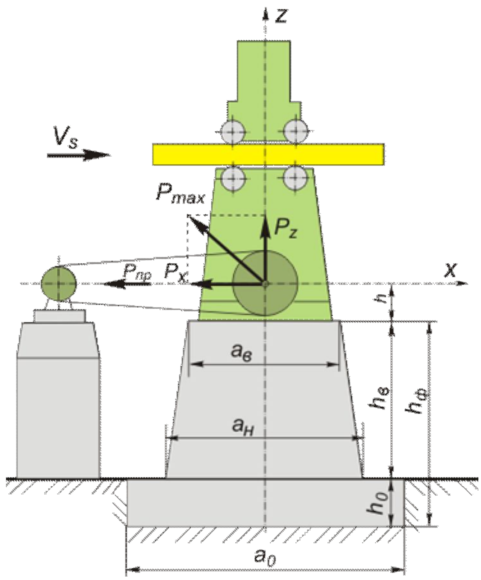

Fig. 4. Design model of the foundation for a frame saw

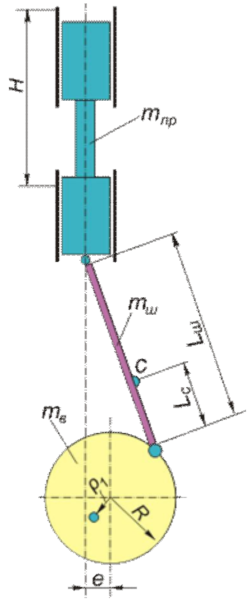

Fig. 5. Diagram of the crank-slider mechanism of the frame saw

The maximum value of P_x is reached at $\sin\omega t = 1$, i.e. at rotation angles of 90^0 and 27^0.

If the electric motor is installed on a separate foundation, then the force arising from the drive is taken into account

$$P_{np} = 2P_k = \frac{4N_{np}}{D_ш\ \omega} = \frac{120 \cdot N_{np}}{\pi\ D_ш \cdot n}, \tag{14}$$

where P_k – the circular force arising during belt drive operation; N_{np} – the drive power; $D_ш$ – the diameter of the drive pulley installed on the crankshaft.

2. Determination of the mass and area of the foundation base

The following formulas were used to determine the mass of the foundation

$$A_z = Z_2 = \frac{P_{z\max}}{M \cdot \sqrt{\left(\frac{K_z}{M} - \omega^2\right)^2 + \left(\frac{K_z \cdot \Phi_z \cdot \omega}{M}\right)^2}},$$

$$\beta_z = \sqrt{\frac{K_z}{M} - \left(\frac{K_z \cdot \Phi_z}{2 \cdot M}\right)^2}, \quad \frac{\beta_z}{\omega} = K_\psi, \quad \beta_z = K_\psi \cdot \omega.$$

After transformations

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$$K_\psi^2 \cdot \omega^2 = (K_z/M) - (K_z/M)^2 \cdot (\Phi_z/2)^2,$$

$$(K_z/M)^2 \cdot (\Phi_z/2)^2 - (K_z/M) + K_\psi^2 \cdot \omega^2 = 0,$$

a quadratic equation with an unknown K_z/M was obtained

The solution to this equation using the well-known formula is denoted by $Y_{1/2}$

$$Y_{1/2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}, \quad Y_{1/2} = \frac{K_z}{M} = \frac{1 \pm \sqrt{1 - 4 \cdot (\Phi_z/2)^2 \cdot K_\psi^2 \cdot \omega^2}}{2 \cdot (\Phi_z/2)^2},$$

$$\frac{K_z}{M} = \frac{2 \cdot \left(1 - \sqrt{1 - (\Phi_z \cdot K_\psi \cdot \omega)^2}\right)}{\Phi_z^2} = Y. \qquad (15)$$

Then the amplitude of the foundation vibrations

$$A_2 = \frac{P_{z\max}}{M \cdot \sqrt{\left(Y - \omega^2\right)^2 + \left(Y \cdot \Phi_z \cdot \omega\right)^2}}.$$

Hence the mass of the installation

$$M = \frac{P_{z\max}}{[A_z] \cdot \sqrt{(Y - \omega^2)^2 + (Y \cdot \Phi_z \cdot \omega)^2}}, \qquad (16)$$

where

$$[A_z] = \frac{7265}{n^{1,847}}; \quad [A_z] \le 0,2\text{мм}.$$

$$m_ф = M - m_{пил},\ K_\psi = \frac{\beta_z}{\omega} \ge 2. \qquad (17)$$

Next, the area of the base of the foundation F_0 is determined, taking into account the following dependencies:

$$K_z = C_z \cdot F_0;\ F_0 = \frac{K_z}{C_z};\ n_z = K_\psi \cdot n.$$

If

$$\beta_z = \frac{60}{2 \cdot \pi} \sqrt{\frac{K_z}{M} - \left(\frac{K_z \cdot \Phi_z}{2 \cdot M}\right)^2};\ \Phi_z \to 0,$$

then

$$\beta_z = 9,55 \cdot \sqrt{\frac{K_z}{M}} = 9,55 \cdot \sqrt{\frac{C_z \cdot F_o}{M}}; \quad K_\psi^2 \cdot n_z^2 = 9,55^2 \cdot \frac{C_z \cdot F_o}{M}.$$

Finally, the area of the base

$$F_o = \frac{K_\psi^2 \cdot n^2 \cdot M}{9,55^2 \cdot C_z}, \qquad (18)$$

where C_z – the coefficient of elastic uniform compression of the soil which is calculated by the formula [2]

$$C_z = C_0 \cdot \left[1 + \frac{2\cdot(a_o + b_o)}{\Delta_1 \cdot a_o \cdot b_o}\right] \cdot \sqrt{\frac{M \cdot g}{F_o \cdot p_0}}, \quad (19)$$

where $p_0 = 2\cdot 10^4$; $\Delta_1 = 1$; $F_o = a_o \times b_o$.

Taking the coefficient of the width of the foundation $K_ш$ in the range of 0.7… 0.8, we obtain

$$b_o / a_o = K_ш;\ b_o = K_ш \cdot a_o;\ \ F_o = K_ш \cdot a_o^2.$$

After the transformations were carried out, the area of the foundation base was determined

$$F_o = \left[\frac{K_z}{C_0} \cdot \sqrt{\frac{p_0}{M \cdot g}} - \frac{2\cdot(1+K_ш)}{\sqrt{K_ш}}\right]^2. \quad (20)$$

3. Calculation of the optimal dimensions of the foundation

If the minimum cost of foundation construction is taken as the criterion for optimizing the size of the foundation, then the cost of concrete and concrete works is the most important component in it. Therefore, the foundation that has a smaller mass will be cheaper.

The mass of the installation (16) and the area of the foundation base (18) depend on the coefficient of vibration resistance of the foundation $K_\psi = \beta_z/\omega$ (Fig. 6).

From the graphs (Fig. 6) it can be seen that with the growth of K_ψ, M drops, while F_o increases.

The desire to reduce the mass of the installation leads to an increase in the area of the base, which is limited by the size of the workshop and the presence of other machines. Therefore, the area of the base acts as a restriction.

Take the permissible area of the foundation base

$$F_{доп} = (5\ldots10) A_n \cdot B_n, \quad (21)$$

where A_n, B_n – the length and width of the frame saw foundation plate.

Taking into account the permissible value of the area of the foundation base $F_{доп}$, the mass of the installation is finally determined (Fig. 6).

To determine the mass of the installation M_2 in the case of the accepted

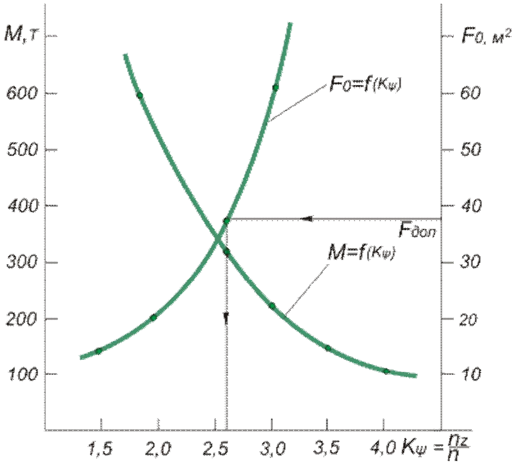

Fig. 6. Dependence of M and F_o on K_ψ

permissible area $F_{доп}$, we substitute its value in equation (19) instead of F_o and get the square root

$$\sqrt{F_{од}} = \frac{K_z}{C_o} \cdot \frac{1}{\sqrt{M_2}} \cdot \sqrt{\frac{p_o}{g}} - \frac{2 \cdot (1 + K_ш)}{\sqrt{K_ш}}, \tag{22}$$

Hence it follows that

$$M_2 = \left\{ \frac{C_o}{Y} \cdot \left[\sqrt{F_{од}} + \frac{2 \cdot (1 + K_ш)}{\sqrt{K_ш}} \right] \cdot \sqrt{\frac{g}{p_o}} \right\}^2, \tag{23}$$

The first value of the installation mass M (16)and the second value of the mass M_2 (23) constitute a system of equations that has a total value Y which depends on the vibration resistance coefficient K_ψ. It is difficult to solve this system of equations by algebraic methods. Therefore, the iteration method is used.

First of all, the value of Y is checked for the existence of explicit roots.

To do this, the value of the discriminant is determined in the formula (15)

$$D = \Phi_z^2 \cdot K_\psi^2 \cdot \omega^2 - 1.$$

If $D>0$, then the roots of the equation are imaginary numbers.

If $D<0$, then the roots of the equation are real numbers.

If the roots are imaginary, then it is necessary to reduce the value of Φ_z or K_ψ. This is achieved either by driving piles or by compacting the soil with cement mortar.If after several attempts, explicit roots are obtained, the problem is solved and the optimal value of $K_{\psi опт}$ is found. The values of $M_{опт}$ and $F_{оопт}$ determine the dimensions of the foundation.

Conclusions

1. The conducted studies show that when the frequency of natural vibrations of the foundation is close to the frequency of its forced vibrations, the phenomenon of resonance occurs, the amplitude of vibrations of the foundation increases hundreds of times.This leads to its destruction.
2. The logarithmic damping decrement serves as the basis for determining the modulus of vibration damping.
3. It was found that an increase in the vibration resistance coefficient allows reducing the mass of the installation with a simultaneous increase in the area of its base, therefore the mass acts as a limitation.
4. It was found out that in order to ensure vibration resistance and prevent resonance of the foundation, the ratio of the frequency of its natural vibrations to the frequency of forced vibrations should be at least 1.5.
5. The calculation of the optimal mass, base area and depth of layingthe foundation is performed according to the criterion of the minimumcost of its construction.

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РОЗРАХУНОК ОПТИМАЛЬНИХ ПАРАМЕТРІВ ФУНДАМЕНТУ ПІД ДЕРЕВООБРОБНІ ВЕРСТАТИ З ВЕЛИКИМИ ДИНАМІЧНИМИ НАВАНТАЖЕННЯМИ

Фундаменти під машини з динамічними навантаженнями повинні задовольняти вимогам розрахунку за міцністю та придатністю для нормальної експлуатації, а також вимогам стандартів безпеки праці в частині допустимих рівнів вібрацій. Коливання фундаментів не повинні вказувати шкідливого впливу на технологічні процеси, обладнання та прилади, розташовані на фундаменті або поза ним. Представлено математичну модель коливань фундаменту і методику розрахунку його параметрів з врахуванням динамічних навантажень від незбалансованих мас та динамічних характеристик ґрунтової основи. Математична модель представляє собою розв'язок диференціального рівняння коливань фундаменту. Встановлено ряд спростувань щодо тіла фундаменту, його основи, геометричного центру і демпфера між фундаментом і ґрунтом. Основою для визначення модуля згасання коливань слугує логарифмічний декремент згасання коливань. Це постійна величина і залежить від пружних і демпфуючих властивостей ґрунту, а такожвідмаси установки. Чим більший логарифмічний декремент, тим швидше відбувається згасання. Виявлено, що збільшення коефіцієнта віброcтійкості призводить до зменшення маси установки з одночасним збільшенням площі його основи, тому вона виступає як обмеження. З'ясовано, що для забезпечення віброcтійкості та не допущення резонансу фундаменту, відношення частоти його власних коливань до частоти вимушених коливань має бути не менше 1,5. Розрахунок оптимальної маси, площі основи і глибини закладання фундаменту виконано за критерієм мінімальної вартості його спорудження. Для проведення розрахунку розроблено ужиткову комп'ютерну програму. Методику проектування фундаменту підверстат з великими динамічними навантаженнями наведено для двоповерхової пилорами.

Ключові слова: модель, ґрунт, диференціальне рівняння, резонанс, логарифмічний декремент, критерій оптимізації, собівартість, комп'ютерна програма.

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CALCULATION OF OPTIMAL PARAMETERS OF THE FOUNDATION FOR WOODWORKING MACHINES WITH LARGE DYNAMIC LOADS

The groundwork for machines with dynamic loads should meet the calculation requirements regarding strength and suitability for regular operation and the need for occupational safety standards regarding acceptable vibration levels. In addition, fluctuations in the groundwork should not cause a harmful impact on technological processes, equipment, and devices located on the foundation or outside it.A mathematical model of foundation vibrations and a methodology for calculating the foundation parameters are presented, taking into account dynamic loads from unbalanced masses and dynamic characteristics of the ground base.The mathematical model is a solution to the differential equation of the foundation vibrations.The article refutes a number of conventional concepts regarding the body of the foundation, its base, the geometric center and the damper between the foundation and the ground.The basis for determining the vibration damping modulus is the logarithmic decrement of vibration damping.It is constant and depends on the elastic and damping properties of the soil, as well as the installation mass. The more significant the logarithmic decrement, the faster the extinction occurs. It was found that an increase in the vibration resistance coefficient allows reducing the mass of the installation with a simultaneous increase in the area of its base, so the mass acts as a limitation.It was established that to ensure vibration resistance and prevent the resonance of the foundation, the ratio of the frequency of its natural vibrations to the frequency of forced vibrations should be at least 1.5.The calculation of the optimal mass, the base area and the depth of foundation laying is carried out according to the criterion of the minimum cost of its construction.An application software has been developed for the calculation. The projection methodology for the foundation for the machine with large dynamic loads is for a two-story sawmill.

Key words: model, ground, differential equation, resonance, logarithmic decrement, optimization criterion, cost, application software.

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Представлено математичну модель коливань фундаменту і методику розрахунку його параметрів з врахуванням динамічних навантажень від незбалансованих мас та динамічних характеристик ґрунтової основи.
Таб. 0. Іл. 6. Бібліогр. 4 назв.

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A mathematical model of foundation vibrations and a technique for calculating the foundation parameters are presented, taking into account dynamic loads from unbalanced masses and dynamic characteristics of the ground base.
Tables 0.Fig. 6.Ref. 4 items.

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