ABSTRACT AND REFERENCES

APPLIED MECHANICS

LATERAL OSCILLATIONS OF A STRAIGHT SECTION OF A TWO CONSTANT BASED HETEROGENEOUS PIPELINE (p. 4–7)

Vaqif Gadjiev, Khaqani Jafarov

The study focuses on the natural oscillation of a straight section of an invariably heterogeneous elastic pipeline lying on a two-constant base devised by P. L. Pasternak.

The elasticity module and the specific density are regarded as a continuous function of the pipeline length coordinate, whereas the continuous function is a function that characterizes heterogeneity of the elasticity module together with its first and second derivatives. Hereby, the equation on the motion-relative deflection is a linear equation with variable coefficients of the fourth order. The problem is solved in a combined way: the first stage involves a variables separation method, whereas the second stage is carried out by the Bubnov-Galerkin orthogonality method. Specific values are calculated in the first approximation; the findings are presented in tables and graphs that illustrate dependencies between the circular frequency and heterogeneity-specifying parameters. The calculation results show a significant impact of heterogeneity upon the value of circular frequency and depend on the law of heterogeneity distribution.

Keywords: heterogeneity, pipe, continuity, base, frequency, elasticity module, density.

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A NUMERICAL AND EXPERIMENTAL STUDY OF HYDROELASTIC SHELL VIBRATIONS (p. 8–12)

Alexandr Shupikov, Sergii Misiura, Vladimir Yareshchenko

The paper presents numerical and experimental research on hydroelastic and elastic shell vibrations. It suggests methods for calculating natural vibration frequencies of constructions placed in the vacuum as well as their vibration frequencies while interacting with water. Testing a cylinder reservoir and a conical shell has proved the effectiveness of the suggested approach and confirmed the reliability of the findings. Filling a liquid in a construction significantly alters its dynamic properties, thus studying the vibrations of shells containing liquids in their inner cavities poses an important scientific and technical task.

We have studied how a liquid influences vibration frequencies in a cylinder reservoir. The calculation results based on the suggested method were compared with the analytical conclusion and experimental findings. The natural frequency reduction factors obtained with the suggested method were close to the analytical conclusion and experimental findings. The research proved that their divergence fluctuates between 0.1 % and 2.8 %.

Similar research was conducted for a conical shell, with numerous findings being compared to the experimental data. The divergence made up 2.0 % for vacuum vibrations and 7.0 % for vibrations of shells filled with a liquid.

Keywords: hydroelastic vibrations, finite elements method, natural vibrations, spectral analysis.

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OPTIMIZATION OF PARAMETERS OF AUTO-BALANCERS FOR DYNAMIC BALANCING OF IMPELLER OF AXIAL FANS BY 3D MODELING (p. 12–17)

Lubov Olijnichenko, Gennadiy Filimonikhin

Optimize the parameters of ball-type auto-balancers for balancing of dynamic unbalance of the impeller axial fan by minimizing the time of occurrence of auto-balancing. Apply the theory of multifactor experiments. The experiment was conducted virtually. 3D-model of the fan and AB were created in computer CAD SolidWorks. The model corresponds to the full-scale axial fan № 4 Series FA 06-300. The dynamics were simulating with using of the module Cosmos Motion. The experimental results were processed by software package for statistical analysis STATISTICA.

We find the domains of parameters inside of which time of onset of auto-balancing does not exceed the specified time.

It is established that in a selected range of variation of optimized parameters, auto-balancing fastest occurs at the lowest stiffness and the greatest viscosity of the supports of the fan. Just found that the decrease of the mass of the ball, in general, increases the time of occurrence of auto-balancing.

It is shown that the proper choice of the parameters of AB and supports of fan can provide offensive of auto-balancing for 6–7 sec-

onds and without optimization of parameters this time may exceed 75 seconds.

Keywords: axial fan, auto-balancing, optimization of parameters, dynamic balancing, 3D-simulation, multifactorial experiment.

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INTERACTION OF THE ZYMNE MONASTERY BUILDINGS WITH THE SOIL BASE UNDER SEISMIC LOADS (p. 18–23)

Volodymyr Sakharov

The work presents numerous research findings on the stress-strain state of a building within the "base–basement–construction" system under a seismic load. The soil array was considered as volumetric nonlinear elastic viscose and plastic environment with a new computed behavioral pattern. The latter accounts for peculiarities of viscose and elastic deformation of marginally stiff soil under a dynamic load, elastic and plastic deformation regarding structural strength and possibilities of strengthening, and energy loss in interaction with the environment. We have revealed the underlying principles of the model. Problems can be solved effectively by the FEM-based variety of the central difference method for heterogeneous systems, which allows to increase the average time integration step and to make effective use of parallel solution methods. As an example, there was created a three-dimensional model of the Assumption (Uspensky) Cathedral of the Zymne Monastery. The modeling was based on the automated system for scientific research "VESNA-DYN" and a modified (explicit) central difference method. According to the findings, seismic loads result in irreversible plastic deformations that significantly impact the stress-strain state (SSS) of constructions. The analysis has exposed the areas of stress concentration that lead to possible damages of constructions. The research has traced emergence and evolution of a tilt resulting from irreversible soil deformations. We have estimated the overall carrying capacity of the church structures.

Keywords: seismic survey, explicit method, nonlinear modeling, soil model, automated system for scientific research (ASSR) "VESNA-DYN".

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EXPERIMENTAL STUDY OF ADJUSTABLE THROTTLE INFLUENCE ON THE LINEAR PARAMETERS OF THE HYDRAULIC SYSTEM (p. 24–28)

Vsevolod Chuiko

Analysis of the approaches to solving the problem of operational control of the hydraulic system parameters was performed in the paper. The paper describes a method of providing uniform motion of the output link of the hydraulic motor by setting the adjustable throttle on the discharge manifold of the hydraulic system. Throttle generates pressure pulsations in the discharge chamber, which compensate sharp pressure increase in the pressure chamber of the hydraulic motor. Throttle parameters, providing a constant speed of the output link are calculated. Based on the calculation results, the design of an adjustable throttle with a rotating spool is developed. The description and operation principle of the designed adjustable throttle, the scheme of its inclusion in the hydraulic network are given. The developed test bench of the throttle and its operation principle are described. The paper presents the results of functional tests of the designed adjustable throttle. The results of theoretical and empirical research, based on which it was concluded on a fundamental confirmation of the proposed method of pulsation dampening in the hydraulic system are compared.

Keywords: hydraulic drive, linearity, throttle, profiling, surface, motion, speed, stand, spool, rotation.

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DEVELOPMENT OF THROTTLE SELECTOR OF SIGNIFICANTLY DIFFERENT PRESSURES FOR GAS-DYNAMIC TOOLS (p. 28–33)

Ihor Dilay, Zenoviy Teplukh

The results of the study of the developed scheme of the selector of significantly different pressures, based on combining flow and pressure dividing valves with flow summarizing valve, allowing a proportional increase of all interthrottle pressures of the scheme are presented in the paper. The mathematical models that provide a choice of optimal parameters of the scheme elements and the study of the effect of the influence factors on the operation quality of the throttle selector scheme are obtained. These models are a system of n nonlinear algebraic equations that can be solved by known numerical methods.

Using pressure reproduction tools, based on the developed scheme is especially relevant for gas-dynamic synthesizers of mixtures with a given composition with microconcentrations of components. Due to providing a linear change of interthrottle pressures in the scheme and applying gas-dynamic synthesizer of linear metering capillaries in the mixer, there is the prospect of obtaining complex multicomponent mixtures with microconcentrations of components with higher concentration maintaining accuracy than in the known tools for the continuous preparation of mixtures with given composition.

Keywords: throttling scheme, linear pressure change, pressure and flow dividing valve, capillary.

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THE INFLUENCE OF SHAPE AND TYPE OF SOWING DISC CELLS ON THE SEED DOSAGE QUALITY (p. 33–36)

Katherina Vasylkovska, Olexiy Vasylkovskyy

Parameters of peripherally located cells were substantiated, and the influence of their step on the seeds uniformity in a row was determined. Difference in the seeds pitch in the sowing disk for sugar beet seeds ranges from 2.6 to 6.6 mm for round-shaped holes, and from 0 to 1 mm for cells, formed by a suction hole and shovel. That is, using cells, formed by the suction hole and shovel, will provide greater dosage uniformity initially.

According to the research results, section of sowing machine for seeding cultivated crops, in which the proposed pneumatic device with a peripheral arrangement of cells and passive device for removing excess seeds by inertia method was used, was designed to exclude the major shortcomings of modern pneumatic sowing machines and improve their performance.

Keywords: cell, dosage quality, distribution uniformity, sowing disc, pneumatic sowing machine.

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INCREASED EFFICIENCY OF TRUCK PULLING UNITS USING STEPLESS HYDROSTATIC-MECHANICAL TRANSMISSION (p. 37–44)

Vadim Samorodov, Alexander Ostroverh

Truck pulling unit is a self-propelled machine that moves on all types of roads and is designed for the development, maintenance and overhaul of oil and gas wells. One of the most time-consuming operations, performed by the machine is "lowering - lifting" of pipes, weight of which can reach 80 tons or more. In Ukraine, this type of machines is manufactured by the Kharkov Plant of Transport Equipment (HZTO) on all-wheel drive (6x6) chassis of the truck KrAZ-63221-02, lifting capacity of which is 80 tons UPA-80PKh. This unit has eight speed transmission ranges in the "lifting" operation mode, which are provided by speed manual transmission, and winch band brake, which overheats and breaks down because of cyclic operations is a key braking element in the "lowering" operation mode.

The authors propose to install stepless hydrostatic-mechanical transmission with foreign or domestic hydraulic units instead of a manual transmission of the truck KrAZ-63221-02, intermediate support and helical gear unit.

Compiled and analyzed mathematical model of the proposed transmissions indicates that the use of stepless transmissions on the UPA-type machines is promising and feasible since this transmission can be used in two operation modes of "lowering - lifting". Herewith, band brake becomes an auxiliary element, and transmissions provide the operation of units with the weight of up to 100 tons.

Keywords: hydrostatic-mechanical transmission, KrAZ, UPA, chassis, principal and kinematic scheme, well.

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MACHINE PARTS ASSEMBLY METHOD, WHICH PROVIDES CONNECTION ACCURACY (p. 45–49)

Nataliya Lamnauer

The machine parts assembly method based on determining minimum values of the absolute deviations of linear dimensions from

the nominal dimension is proposed. Searching methods, ensuring assembling accuracy is an important issue of mechanical engineering technology. It is proved for existing distribution laws of random variables – linear dimensions that the variance of the minimum value of the absolute deviations of the linear dimensions from the nominal dimension is ten times smaller than the variance of the random variable – linear dimension. It was found that high accuracy is achieved by the ordered arrangement of the values of the absolute deviation of the linear dimension from the nominal dimension and a selection of two machine parts with a minimum of these values for the assembly. This method will allow to ensure high assembling accuracy by the linear dimension parameter. This method can be used for a small statistical sample as well.

Keywords: method, assembly, connection, machine parts, quality, accuracy, linear dimension.

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DEVELOPMENT OF CALORIMETRIC MOTOR FUEL FLOWMETER WITH INCREASED METERING ACCURACY BY ADJUSTING THE INLET TEMPERATURE (p. 50–54)

Andrey Ilchenko, Elena Bezvesilna

In the paper, the emphasis is made on the diversity of motor-transport operation conditions and factors which should be considered while developing modern motor fuel flowmeters. It is shown that calorimetric flowmeters correspond to the motor transport operating conditions, fuel flow metering standards and can be recommended for their usage in the process of automobiles exploitation. They also can be useful for the bio-fuel flow metering.

A concept of a new calorimetric motor fuel (bio-fuel) flowmeter with adjusting the inlet temperature was developed for the car engines, having up to date supply systems (the systems of reverse fuel decanting into the tank (through recoil lines)), which allows to increase the accuracy of motor fuel flow metering.

Field researches of brassboard at the automobile have shown the decrease (compared to the prototype of flowmeter) in the relative accuracy of diesel oil flow by 7–13 % depending on the engine behavior.

Keywords: engine, temperature, metering, calorimeter, heat transfer, capacity of heat transmission, flowmeter, fuel, bio-fuel, flow.

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DESIGN OPTIMIZATION OF DIAMOND WIRE BEAD FOR HARD FACING STONE (p. 55–60)

Sergii Bashinskyi, Volodymyr Kotenko, Sergii Kalchuk

The dynamic of the diamond wire single bead moving in the natural stone cutting is considered in this research. The relation between the angle of the tension force declination from the diamond bead long axis and the curvature radius of the saw cut surface is found on the basis of the diamond bead position geometric modeling. This empirical equation allows simplifying the mathematic model equations of the diamond bead wearing. The simplifying equations are put as a basis of interactive model of the diamond bead wearing. The model is built in the multibody dynamics simulation software "MSC.Adams". This software was chosen as it includes the Cable Module which allows to design and analyze the cable systems in discretized mode. This feature satisfies more the character of the diamond wire working in the cutting of the natural stone. The analysis of the software modeling results shows that the rate of the diamond bead conical wearing does not depend on the cutting force factors and this rate is determined by the saw cut curvature radius only. The relation between these parameters is determined by the empirical equation. The solving of the equation with the characteristic initial data for the hard natural stone cutting is the mean value of the diamond bead conical wear angle. The calculated value of the conical wear angle is the basis of the improvement construction of the diamond wire bead for the hard natural stone sawing.

Keywords: cone, diamond bead, wear, modeling, force parameters, MSC.Adams

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