ABSTRACT&REFERENCES

APPLIED MECHANICS

DETERMINATION OF ELASTIC-HEREDITARY ENVIRONMENTS DURABILITY USING GENERALIZED DESTRUCTION CRITERIA (p. 4-7)

Vitaly Dyrda, Alexander Tolstenko, Yevgeny Kalgankov

The classical theory of elasticity is not always applicable to the elastic-hereditary environments. The conventional destruction criteria (assumed stresses and assumed deformations) are acceptable under static loads, under cyclic loads they are of little use.

The applicability of generalized destruction criteria - entropic, dissipative type and the level of material damage has been considered for determining the durability of elastic-hereditary environments.

The analysis of elastic-hereditary environments durability was based on the entropic destruction criterion and destruction criterion by the extent of material damage. In both cases, experimental researches of macro- and micro- structures are required. The calculation of elastomeric constructions durability based on the destruction criterion of dissipative type is possible without experimental methods, using table values.

The example of calculation of durability in dangerous areas of elastomeric constructions destruction is given from the literary data. Coincidence of calculated and experimental results is satisfactory

Keywords: durability, criteria, destruction, elastic-hereditary environment, entropy, stresses, deformation, elastomers, constructions, rubber

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WEAR RESISTANCE AS ENERGY CHARACTERISTIC OF MATERIAL STRENGTH IN FRICTION AREA (p. 8-11)

Valerii Kramar, Miroslav Kindrachuk, Vladimir Loburak

The purpose of the research is to investigate the destruction processes in coating materials during friction. These researches have been conducted on composite electrolytic coatings with titanium carbide and silicon carbide powders used as fillers. The assessment of surface layer destruction has been performed using the methods of theoretical and experimental research results analysis as part of an energy model based on wear particles formation in surface areas of a friction pair. Besides, the dependence of wear particle size on the mechanical properties of material has been determined.

The analysis shows that material is destructed faster for carrying particles of larger sizes during friction. This means that materials with a higher hardness have a smaller size of carrying particle and materials with higher strength have a bigger size of carrying particles

Keywords: friction, wear particles, composite coating, dislocation, structure, hardening, crystal lattice

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STRUCTURAL AND TECHNOLOGICAL FEATURES OF HOES (h. 12-14)

Gennady Semchuk, Anatoly Dudnikov, Anatoliy Myaleshka, Vitaliy Gulenko

The paper gives the research results and experience of practical applying the processes based on using vibrations on the workpieces.

Various aspects of improving the operating life of tillage machines (cultivators) working elements are shown.

The attempts of determining the optimal design and technological features of hoes, such as size, shape, crumbling angles, cutting angle, blade sharpening angle and cutting edge thickness, have been made.

It is shown that the crumbling angle exerts substantial influence on the degree of soil loosening, which determines the quality of processing.

The recommendations on the choice of hoes thickness depending on the width, width of the wing, physical and mechanical properties of material and properties of the soil are proposed.

The features obtained will be used in developing a method for hoes deformation vibration recovery.

Keywords: opening angle, crumbling angle, width, width of wing, hoe thickness

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AN EFFICIENCY INCREASE METHOD OF MACHINING MATCHED SURFACES OF PARTS FROM POLYMER COMPOSITES (p. 15-19)

Anatoliy Tarasyuk, Volodymyr Samchuk, Yurij Sychev, Bengard Lyakh

All artificial constructions exist due to the presence of functional connections between their elements that are realized as connections.

Now with introduction of new perspective materials having original physical and mechanical properties, foremost polymer composites, the problem of manufacturing accuracy of matched surfaces connections of both parts from composite materials with each other and with metal parts has appeared. In the article the method of machining matched surfaces of connected parts made from polymer composite materials is offered, it consists of simultaneous treatment of engulfed surfaces and those one that engulfs surfaces taking into account the law of motion conservation of mass centre, the law of conservation of motion amount and the law of conservation of kinetic moment systems, which allows to compensate forces of cutting and to decrease the resilient moving in the technological system and to increase efficiency (productivity, accuracy and quality of surfaces) of machining. The construction of device is also offered for the simultaneous cutting of internal and external screw-thread, its work is supposed to observe some above mentioned laws of mechanics

Keywords: matched surfaces, geometrical parameters, polymer composite materials, machining

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UNIFORM THEORY OF MOVERS ON CONTINUOUS FLOWS. BRIEF THEORY OF COUNTER-ROTATING PROPELLERS (p. 20-28)

Borys Mamedov

The developed brief theory of the counter-rotating propellers is a logical chain of a series of articles relating to the development of the theory of one-row propellers, brief theory of counter-rotating propellers, brief theory of concurrent-rotating propellers, a comparative analysis of one-row, counter-rotating and concurrent-rotating propellers in order to select the most effective variant. It is shown that counter-rotating propellers have high energy consumption and very low flight (traction) EF (efficiency factor), 35% and 7.5% respectively on the first and second rotor wheels. Therefore, the ultimate goal of a series of articles will be: to show and prove that among the one-row, counter-rotating and concurrent-rotating propellers the latter are the most efficient, as they allow to completely eliminate the main drawback of one-row and counter-rotating propellers associated with the kinematic zone of rigid (elastic) impact, Figure 1, section B1-B1, generating powerful impact waves in an oscillatory mode into environment. Another drawback of the counter-rotating propellers is the flow swirling after the first rotor wheel, regulating the counter flow swirling at the entry of the second counter-rotating rotor wheel, which in turn regulates the higher hydrodynamic load of the blades edges of the second counter-rotating rotor wheel and low speed compared to the first. Hence, the next article will cover the creation of the brief theory of concurrent-rotating propellers, which contains their full analysis

Keywords: kinematic analysis, counter-rotating propellers, blown profile thrust capacity, lifting capacity

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GAUSSIAN CURVATURE AS MEANS FOR REDUCING THE INFLUENCE OF GIPERSONIC MOTION N-WAVE ON SENSOR (p. 29-31)

Volodimir Karachun, Viktorij Mel'nick

The subject of research is the industrial sample of the inertial sensor in the form of a two-axis gyroscope with liquid and static suspension.

The possibility of reducing the acoustic error under hypersonic motion is analyzed using the methods of design and technological solutions.

The purpose of the paper is comparative analysis of the bench and seminatural tests of differentiating gyroscope with the analytical assessment of the measurement error under the influence of N-wave at zero and finite Gaussian curvature of the float suspension.

The effect of the acoustic float impedance increasing by the change in the meridian suspension line geometry was used as the method of passive sound insulation of inertial sensor from the effects of penetrating acoustic emission.

Comparative analysis of the bench instrument acoustic error and analytically detected non-zero Gaussian curvature for suspension gives grounds for decision-making on reduction of the gyroscope systematic inaccuracy under hypersonic motion.

The results may be used in the inertial positioning means design and external target designation.

The proposed method outlines a number of issues for practical providing of acoustic comfort of the onboard equipment using the passive methods

Keywords: N-shock wave, systematic inaccuracy, Gaussian curvature, hypersonic motion, suspension

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PNEUMATIC UNIT USE WITH BUILT-IN TANK IN METAL ROLLING HALLMARKING IMPACT MECHANISMS (p. 32-35)

Jurij Atamanov, Gennadyj Krytikov, Maryana Strizhak

The paper considers the problems of selection of pneumatic impact drive structure and its mathematical model. It gives the results of the PC testing of the pneumatic actuator activation process using various wiring schemes of actuating mechanism.

It is shown that one of the most efficient schemes of pneumatic impact actuator is the scheme with the built-in tank (accumulator).

The proposed mathematical model of pneumatic impact unit is universal and allows studying pneumatic actuators with the built-in tank with various schemes and control algorithms. During the research of internal transient processes in addition to pressure the temperature change in the pneumatic unit cavity while its activation was also measured. It is shown that conventional wiring scheme of impact pneumatic cylinder is accompanied by an oscillatory process, which complicates its use in hallmarking units.

Based on the PC research it is determined that pneumatic scheme with cylinder and air distributor operation synchronization allows achieving the most efficient pulse impact which in the area of movement of 0.15m provides the motion speed of the output link of about 4 m/s.

This mode is the most applicable for the hallmarking, broaching and forging processes

Keywords: pneumatic impact actuator, hallmarking mechanism, mathematical model, cylinder and air distributor operation synchronization

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MODELING OF FLOW IN DIFFUSSER CHANNEL WITH TURBULATORS (p. 36-38)

Yuriy Tereshchenko, Ekaterina Doroshenko, Larisa Voljanskaja

Flow separation is one of the most complex current phenomena accompanying the flow in a compressor. Separation in the blade rows leads to abrupt changes of compressor parameters. The flow separation in the blade rows is caused by wide angles of blades attacks and high pressure gradients in the inter-blade channels respectively.

The flow separation can be avoided by applying various methods of power redistribution between different flow areas in curved diffuser inter-blade channels of axial flow compressor stages. One of the methods is the forced flow turbulization from the blades surface.

Turbulization can be achieved by installing vortex generators on the blades surface in the form of discrete hollows or projecting above the surface.

The objective of the research was studying the flow in diffuser channel with turbulators. The influence of allocation and geometric size of turbulators on the changes of boundary-layer displacement thickness in the diffuser channel exit sectionhas been analyzed.

The numerical experiment has been used for the research. The results of numerical analysis have shown that allocation of turbulators in the input section of the channel is the most effective. The numerical modeling results have been compared to results of physical experiment

Keywords: diffuser channel, turbulator, boundary layer

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MODEL OF POLYMER MELT FLOW (p. 39-41)

Vitaly Levanichev

The model of polymer melt flow has been developed and the equation of full rheological curve of non-Newtonian fluid without empirical power-law dependences has been first obtained. It is assumed that in a steady mode mainly a plug flow can be developed and rheological curve is a change in the melt geometry at the wall area due to the melt relaxation decrease at higher flow rates. The non-Newtonian flow area is formed when the flow and relaxation rates are approximately equal.

The non-Newtonian flow occurs in the areas of low and high shear rates, with decreasing interaction of flow and relaxation processes. The equation allows estimating the transition points (viscosity and shear rate) between the flow areas. It is shown that the effective contact area is decreased faster than the shear stress is increased, so the viscous friction force is reduced at the non-Newtonian flow area.

The model enables to study the interaction at the wall area of the flow, it is important for extrusion high-speed processes, in small-scale production with frequent readjustments and composition changing

Keywords: non-Newtonian fluid, rheology, flow model, relaxation, polymer melt

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MATHEMATICAL MODELING AND STUDYING OF PHYSICAL PROCESSES IN HYDRAULIC TURBINE SETTINGS (p. 42-48)

Andrey Rusanov

The results of using the methods for mathematical modeling of computational investigation of viscous incompressible flows in vertical-axial Kaplan turbine and radial-axial pump turbines settings are presented.

The flow modeling has been made based on numerical integration of the Reynolds equations with an additional term containing the artificial compressibility. The SST Menter differential two-parameter model was used to take into account turbulent effects. The mathematical model has been implemented in the FlowER-U software complex.

The analysis of calculations results allowed obtaining new data on the spatial flow structure and power losses, determining the flow features in each element. A satisfactory agreement of calculations and experimental data has been obtained, based on which the possibility of applying the FlowER-U software complex for developing and improving turbine settings of hydraulic turbines has been defined

Keywords: numerical simulation, viscous flow, turbine setting, hydraulic turbine, pump turbine

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MODELING OF TECHNOLOGICAL PROVIDING OF OPERATING PROPERTIES OF SURFACES OF HARDENED LARGEMODAL GEAR-WHEELS

(p. 49-55)

Yriy Timofeev, Alexander Klochko, Alexay Kravcov

The system of complex parameters, which is used for technological providing of operating properties of hardened large modal gear-wheels, and the technique of two-level providing of these properties, using graphic methods of system optimization were considered. The technological parameters for providing of operational properties of evolvment surfaces of hardened largemodal gear-wheels, their systemic analysis and experimental researches results were presented.

The study has shown that for hardened gear-wheels, their parameters, such as teeth breakdown, active surfaces chipping and teeth upper layers flaking, teeth abrasion, plastic teeth deformations and scoring with the same regulated quality parameters of hardened gear-wheels surface, had the smaller dispersion of scattering than when using conventional technique of surfaces condition regulation.

Also, the introduction of modeling of technological providing of hardened gear-wheels surfaces operating properties, using the system optimization, allows the fullest use of opportunities of their treatment methods when developing technological processes

Keywords: complex parameters, technological providing, operating properties, gear-wheels, system optimization

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DISTRIBUTION OF INTERNAL AND REACTIVE FORCES WHILE COMPOSITE BEAMS BENDING

(p. 55-59)

Stanislav Kovalchuk

In the paper the distribution of internal and reactive forces while modeling the composite beams bending using an iteration shear model has been analyzed.

Based on stress-strain relations of the model analytical relations have been obtained for determining internal forces - bending moments and shear forces in case of statically indeterminate beams, made of heterogeneous composite material, pliable to shear deformations.

The influence of shear pliability of beam material on the internal forces form and value and reactive forces intensity has been defined.

It is theoretically shown that accounting of shear pliability of beam material does not break the pattern of internal forces distribution, corresponding to the conventional model, but specifies their values with additional fixations leading to static indeterminacy of the task.

The results of experimental and theoretical researches of reactive and internal forces in statically indeterminate beams have been given

Keywords: internal force, reactive force, bending, composite, beam, shear, iteration

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FLUIDS FLOW WITH HYDRODYNAMICALLY ACTIVE ADDITIVES THROUGH VARIABLE CROSS-SECTION CHANNELS (p. 59-63)

Oleg Jahno, Roman Gnativ

Various local resistances in pipeline systems cause flow turbulence. This leads to higher energy consumption required for fluids transportation in pipelines, and poor operating properties of the latter.

In the paper the effect of polyacrylamide additives (PAA) on local resistances of pipeline systems was studied. Mathematical model of describing the fluids flow with hydrodynamically active additives through variable cross-section channels was proposed.

Interest in hydrodynamics of weakly concentrated polymer solutions is caused by the possibility of reducing the resistance of bodies motion in a fluid and flow in pipelines. Depending on resistance geometric characteristics and additives concentration, they can lead to both decreasing and increasing of local pressure losses in a pipeline.

Based on research results, devices were proposed based on the effect of reducing or increasing the local pressure losses using additives

Keywords: Toms effect, local resistances, hydrodynamically active additives

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