ABSTRACT AND REFERENCES

APPLIED MECHANICS

THE STUDY OF DYNAMIC LOAD ON A WAGON-PLATFORM AT A SHUNTING COLLISION (p. 4-8)

Alyona Lovskaya, Andrey Rybin

In order to increase the volume of cargo transportation through international transport corridors that pass through Ukraine, container transportation has been developed. To ensure the safety of a wagon-platform with containers placed on it, the research of dynamic loads acting on them at shunting collision has been conducted in real operating conditions.

The research results led to the conclusion that the largest values of acceleration acting on the wagon-platform with containers placed on it during a shunting collision occur in the presence of gaps between the fitting stops and fittings and amount, respectively, about 90 m/s^2 and 110 m/s^2.

The approbation of obtained acceleration values was performed by computer simulation of the dynamics of a wagon platform with containers placed on it under the action of the longitudinal impact force of 3.5 MN on the back gauge of automatic coupling.

Verification of the model was tested by the Fischer criterion. This revealed that the hypothesis of the adequacy of the model was not disputed.

Conducted research will improve operational safety of the wagons in the combined transportation, and will motivate design of wagons of the new generation for use in combined international traffic.

Keywords: wagon-platform, bearing structure, container, dynamics, simulation, shunting collision, construction load, acceleration, combined transportation.

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RESEARCH INTO MUTUAL INFLUENCE OF INCLUSION ON THE CHAIN OF PORES IN THE WELDED SEAM UNDER THE INFLUENCE OF THERMO-FORCE LOADING (p. 9-14)

Elena Strelnikova, Oleg Kovch

Geometric characteristics of the inclusion to the chain of pores in the weld under the conditions of asymmetrical thermo force loading were studied. The dependence of an acute angle of the inclusion on the crack opening in the weld seam is explored. The dependence of the scheme of mounting of a construction on the crack opening in the weld was studied. A method based on the method of the finite elements of determining a stress-strained state in the weld in the pore and inclusion was developed. The method makes it possible to estimate in space mutual influence of the inclusion on the origin and crack opening in the pore. This method will make it possible to increase the period of operation of the welded seams.

The special feature of the studies is in creating different loads by time, by the depth of the plates, by the length of the plates and welded seams. The analysis of a stress-strain state of a welded seam in all stages of the loading before full cooling of the structure was examined.

A study of different methods of the load application was carried out. The authenticity of results is determined by the use of engineering methods.

It follows from the obtained results for the pores with diameter of 2.5 mm: a pore and an inclusion in a similar welded seam do not substantially influence each other, the maximal stresses of σ_{eqv}^1=3350 kgs/cm^2 will not lead to crack opening near the pores. The maximal stresses of σ_{eqv}^2=3500 kgs/cm^2 will lead to the crack opening near the inclusion.

In the implementation of the distance between the pore and the inclusion L= 0,875 mm with the diameter of pores of 3.0 mm, prerequisite for a crack opening will arise from the inclusion to the pore for the scheme of rigid mounting of the base of the construction.

In the pore with the diameter of 3.0 of mm, exposed to maxima; temperature, the tension exceeding the adopted σ_{eqv}^1=3600 kgs/cm^2. In the nodes around the inclusion the process of crack opening will occur.

Keywords: inclusion, pore, crack, deformation, stress, mounting, welded seam, temperature load, gas jet.

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ANALYSIS OF THE IMPACT OF IMPELLER OUTLET WIDTH ON THE STEEPNESS OF PRESSURE CHARACTERISTIC (p. 15-20)

Viktoriya Miltykh, Mykola Sotnyk

The impeller outlet width is one of the most important geometrical parameters, which has a significant effect on the pressure characteristic of centrifugal pumps. The steepness of the pressure characteristic, in turn, determines selection of the pump control in the system. Finding a mathematical dependency between them will make it possible to design the impellers of centrifugal pumps with a predetermined steepness.

To find the dependence between the impeller outlet width and the steepness of a pressure characteristic, we carried out numerical simulation. 30 double-entry impellers of centrifugal pumps with a specific speed from 80 to 210 with different values of the width of the impeller were simulated.

Using numerical modeling data, we established dependences between the impeller outlet width b_2 and the steepness of the pressure characteristic K_H, and also consumable parameter q^p, of the view $K_H = a\left(\frac{b_2}{D_2}\right)^{-k}$ and $K_H = E \cdot q^p + F$. The coefficients a, k, E and F in the equations are variable and depend on the design features of impeller. In order to use the established dependencies in the design of any double-entry impellers, it is necessary to determine the main geometric parameters of the impellers, which greatly influence the coefficients a, k, E and F.

Keywords: characteristic curve, pump station, impeller outlet width, centrifugal pump.

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ANALYSIS OF CURVILINEAR MOTION OF TRACKED VEHICLES WITH ELECTROMECHANICAL DUAL-FLUX TURNING MECHANISMS (p. 21-28)

Dmitrij Volontsevich, Duong Sy Hiep, Ievgenii Veretennikov

The results of the numerical simulation of the curvilinear motion of tracked vehicles with electromechanical dual-flux mechanisms of the turning are given. The variants were studied of simple modernization of the mechanical step mechanisms of the turning and gears, which were installed on the tractors of the MTLB family produced in large quantities. These tracked vehicles until now display good results on reliability and passability, but they are substantially inferior to contemporary machines in specific power, protection and ergonomic parameters.

The indicated modernization makes it possible to implement, at insignificant cost, a smooth controlled change in the turning radius of the old tracked vehicles, with partial recovery of deceleration energy. In so doing, the transition from controlling the turning with the aid of levers to the steering-wheel control is facilitated.

As a result of conducted studies, it was established that:

– for modernization without a considerable increase in the power of the diesel engine, the most rational appears to be the scheme with two electromotors that work predominantly in the brake mode, retaining the mechanical branch of a regular transmission of a vehicle;

– with an increase in the specific power up to 24 hp/t, the decrease of gear ratios in the branches of the turning mechanism from 2,6 to 2 will make it possible to increase the turnability of the machine by 11–15 % even without introduction of an electric drive to the turning mechanisms.

Obtained results make it possible, at a minimum cost, to draw the characteristics of the old vehicles on the turnability and ease of control closer to the new requirements and standards.

Keywords: tracked vehicle, dual-flux turning mechanisms, electro-mechanical turning mechanisms, the turning radius.

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A METHOD OF EVALUATING VEHICLE CONTROLLABILITY ACCORDING TO THE DYNAMIC FACTOR (p. 29-33)

Anatoly Turenko, Mikhail Podrygalo, Dmytro Klets, Vasily Gatsko, Marina Barun

The study has explored one of the most important performance properties of the vehicle, which determines road traffic safety, – control in a steady mode. A method has been suggested for evaluating the stability of a vehicle against yaw with regard to the dynamic factor. We have found a dependence of the dynamic factor on the design and operational parameters of the vehicle. The dynamic factor can be reduced through achieving a neutral steering of the vehicle by controlling the ratio of the total lateral rigidity of the tires of the front and rear wheels. It has been determined that a change in the tire air pressure, measured by the developed algorithm, improves vehicle stability against yawing and thus contributes to traffic safety. In the example of the truck Ural-4320, the suggested method was used to determine the total lateral stiffness of the wheels under the condition of ensuring the vehicle’s neutral steering. The study has revealed that in the case of an equipped vehicle it is necessary to reduce the tire pressure in the wheels on the equalizer trolley in correlation to the air pressure in the tires of the front wheels. The research results can be used both in operating the existing vehicles and for designing new ones.

Keywords: controllability, stability, dynamic factor, steady motion, vehicle.

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INVESTIGATION OF THE PROCESS OF CRUSHING SOLID MATERIALS IN THE CENTRIFUGAL DISINTEGRATORS (p. 34-40)

Mykola Sokur, Volodymyr Biletskyy, Lidiia Sokur, Denys Bozyk, Ivan Sokur

The paper represents the results of investigation of magnetite quartzite centrifugal disintegrators crushing. It is demonstrated that when crushing quartzites of ingoing size 100 mm, it is possible to obtain crushed product size – 10 mm, in so doing product classes – 10 mm depends on the disintegrator rotor rotation frequency. It is shown that in crushed products of the centrifugal disintegrator of CD-50 type there are more classes minus 10, 5, 1 and 0.074 mm by 30, 42, 32, 13,5 % respectively, than in crushed products of KMD-2200 cone-type crusher. Herewith, it was established that iron content in CD-50 crushed products is 3.3 % higher, that in KMD-2200 ones.

The obtained empirical dependencies of material destruction process via stroke in the field of centrifugal forces can be applied in performance prediction of material centrifugal disintegrators crushing.

The final formula for calculating the material escape speed out of the accelerated disintegrator rotor, which provides required destruction of material, was obtained by means of classical hypothesis method application. Namely, the required speed of material escape out of the operating cylinder of centrifugal disintegrator is linear to specified material reduction degree and value of admissible (critical) stress of the given material destruction, and inversely proportional to Sin of meeting angle of material with bumper plates and value of material acoustic stiffness.

Carried out empirical and theoretical investigations showed the advantages of magnetite quartzite crushing in centrifugal disintegrator before comminution in cone crushers, which makes the use of disintegrators in schemes of preparation of ore for further concentration well-grounded.

Keywords: crushing, quartzites, size, centrifugal disintegrator, rotor, power costs, mathematical model of material destruction process via stroke in the field of centrifugal force.

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INVESTIGATION OF HEATING OF THE DRILLING BITS AND DEFINITION OF THE ENERGY EFFICIENT DRILLING MODES (p. 41-46)

Andrii Dreus, Anatolii Kozhevnikov, Andrii Sudakov, Katerina Lysenko

The work deals with the study of processes of heat exchange on a working face of a well when drilling with diamond drilling bits. The urgency of the problem stems from the development of new drilling technologies, where a flushing liquid is supplied in a pulse mode. The aim of the study is the justification of the settings of impulse flushing to enable energy-efficient resource-saving drilling mode. By such modes we understand those with the contact temperature not exceeding 600 °C at the specified parameters of drilling.

Experimental study and computer simulation of the processes of heating of drill bits with different modes of flushing were carried out. The task of joint impact of pulse flushing parameters (intervals and pauses) and mode parameters of drilling (flushing fluid consumption and downhole power) on the contact temperature on the working face was solved. On the basis of the obtained data, we designed a nomogram that allows determining the rational values of pause intervals and flushing fluid supply, level of downhole power, flushing fluid consumption, with which energy and resources efficient drilling mode is provided. Thus, the results of this work can be used to control the thermophysical processes on the working face and to select energy-efficient drilling modes.

Keywords: temperature settings, drilling, CFD simulation, energy efficiency, pulse flushing.

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RESEARCH INTO EXCITATION OF DUAL FREQUENCY VIBRATIONAL-ROTATIONAL VIBRATIONS OF SCREEN DUCT BY BALL-TYPE AUTO-BALANCER (p. 47-52)

Gennadiy Filimonikhin, Volodymyr Yatsun, Kostyantyn Dumenko

The 3D model of the screen stand with the vibrational-rotational duct motion was developed. The ball-type auto-balancer, which makes it possible to create the two-frequency vibrations, is used as the vibration exciter. The main parameters, which influence the stability of the dual frequency vibrations, were defined after adjusting and testing the model. It was established that the ranges of the dual frequency vibrations are relatively large, which makes it possible to change the characteristics of vibrations with a change in the parameters from these ranges.

An increase in the summary mass of the spheres increases the amplitude of slow vibrations of the duct masses in direct proportion.

This increases in direct proportion the vibration energy directed toward the execution of the main technical process.

An increase in the unbalanced mass on the auto-balancer case increases the amplitude of rapid vibrations of the duct masses center in direct proportion.

It was established that an increase in the rotation frequency of the rotor increases the amplitude of the rapid vibration speeds of the duct in direct proportion. This increases the vibration energy directed toward the duct self-cleaning and the change through the vibrations of the mechanical properties of the workable material in proportion to the square of rotation frequency of the rotor.

The simulation showed that the auto-balancer works as two separate vibration exciters. In the first one, the spheres rotate practically evenly with the resonance frequency of the duct vibrations, at this, independent of its loads, the spheres automatically adjust to this frequency, by which they excite the slow resonance duct vibrations (12 Hz) with a large amplitude. In the second one, the mass on the AB case excites the rapid duct vibrations with (any) existing non-resonant rotation frequency of the rotor.

Keywords: vibration exciter, dual frequency vibrations, 3D simulation, unbalanced mass, resonance vibrator, auto-balancer, screen.

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DEVELOPMENT OF ALTERNATIVE TECHNOLOGY OF DUAL FORMING OF PROFILED WORKPIECE OBTAINED BY BUCKLING (p. 53-61)

Volodymyr Kukhar, Vadym Burko, Andrii Prysiazhnyi, Elena Balalayeva, Mykyta Nahnibeda

A possibility of application of longitudinal bending (buckling) as an economical way of profiling workpieces, ensuring replacement of pinching impressions and edgers was shown for manufacturing of eye-bolt forgings. For realization of this method of impression-free profiling of blanks, a process of twin forging of eye-bolt forgings was designed as well as the arrangement of the forging facilities. The peculiarity of this process is that the cut-off blank is upset, it loses its stability and thus obtained profiled semi-finished product is turned over on its side and eventually it is put inside the impression for simultaneous forging of two forgings from one blank. It was found that profiled semi-finished items acquired the desired shape at the degree of blank's upsetting equal to 39 %, the central angle between the twin eye-bolts forgings being 54° and it had been taken into account for the dies' design. Experimental forming of eye-bolts forgings according to the proposed and conventional processes on physical lead models of blanks, which helped to find out that the proposed technical solution, can ensure metal saving at 21.7 % level. Comparison of these two methods revealed improved technical and economic indices of the new process; particularly the coefficient of metal consumption at cutting was raised by 1.4 %, the quotient of output of quality forgings by 21.1 % and coefficient of application of forgings metal along the consumption rate by 27.9 %.

Keywords: dual forming, impression–free profiling, profiled workpiece, die-forging of eye-bolt, buckling (longitudinal bending), butts distortion, flash.

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ON THE POSSIBILITY OF APPLYING MODERN DESIGN SOLUTIONS OF OCEAN-TECHNICAL CONSTRUCTIONS FOR THE AZOV SEA SHELF (p. 62-70)

Anastasiia Zaiets

Achieving energy independence is one of the most important issues of modern Ukraine. Solution of this problem is impossible without the exploration of the shelf of the Azov-Black Sea basin; therefore development and design of ocean-technical constructions for the hydrocarbon raw materials exploration in the conditions of the Black and Azov Seas is the main step. In this article we examine selection of the architectural-construction type of an ocean technical construction, taking into account the ice loads, characteristic for the Azov Sea basin. A neural network analysis was perormed of the forecast of the thickness of ice in winter period and the ice loads on several types of constructions were calculated. As a result of the calculations it was revealed that under the considered conditions, the most suitable type of construction is an ice resistant stationary platform of gravitational type, which includes an extended structure with inclined front face at the level (depth) of sea of 8,0 m, and at the depth of 12,0 m is an extended structure with a combination of inclined sections and vertical parts of the columns on the front face.

Performed calculations are also important from the point of view of the decrease of technological works and consumption of materials during construction, since we applied real physical values of ice formations, not the maximal ones registered over 100 years.

Keywords: ocean technical construction, the shelf of the Azov-Black Sea basin, ice resistant platforms, architectural-construction type.

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