Abstracts

Troshchenko V. T. and Khamaza L. A. **Conditions for the Transition from Nonlocalized to Localized Damage in Metals and Alloys. Part 2. Duration of Fatigue Crack Initiation and Propagation Stages** // Problems of Strength. – 2014. – No. 4. – P. 5–20.

A ratio between the durations of fatigue crack initiation and propagation stages is analyzed taking into account the influence of crack sizes corresponding to the crack initiation, the presence of local damages on the specimen surface, the scatter of test results, the stress concentrators, the type of stress state, and other factors. The approaches to identifying the conditions for a transition from dispersed to localized damage are discussed; the paper gives the results of investigation of these conditions, which is based on an analysis of cyclic inelasticity characteristics of metals and alloys versus the number of loading cycles and the rate of propagation of short fatigue cracks depending on the range of stress intensity factor.

Matveev V. V. and Boginich O. E. **The Influence of Inelastic Resistance on Vibrodiagnostic Parameters of the Presence of a Closing Crack in an Elastic Body under Superharmonic Resonance** // Problems of Strength. – 2014. – No. 4. – P. 21–35.

The authors discuss the methods for approximate determination of vibrodiagnostic parameters of the presence of a closing mode I fatigue crack in an elastic body taking into account various types of inelastic resistance under second-order superharmonic resonance.

Strizhalo V. A., *Novogrudskii L. S.*, *and Opravkhata N. Ya.* **On the Critical State of M76 Pearlite Steel under Action of Electric Current** // Problems of Strength. – 2014. – No. 4. – P. 36–42.

A new criterion for assessment of the critocal state of rail steel subjected to electric current pulses is proposed and substantiated. As the critical state criterion we propose to use the condition of equality of the conventional yield stress of the material after cycling operation with further action of electric current pulses and the minimal yield strees regulated by the respective standards.

Stepanov G. V. and Mameev I. A. **Durability of a Stress Concentrotor-Containing Cantilever Beam under Cyclic Loading in Bending** // Problems of Strength. – 2014. – No. 4. – P. 43–49.

The procedure and results of studies on the durability of the cantilever beam metal over the stress concentrator area in pulsed cyclic bending are presented. Comparison of experimental and numerical simulation data resulted in establishing the relation between the durability and inelastic cyclic deformation amplitude the effect of strain hardening and plastic strain rates on durability was elucidated.

Shul'zhenko N. G., *Gontarovskii P. P.*, *and Protasova T. V.* **Influence of the Circumferential Non-Uniformity in the Material Mechanical Properties on the Deformation of Rotors of Power-Generating Units** // Problems of Strength. – 2014. – No. 4. – P. 50–61.

The paper considers the irreversible deformation of steam turbine rotors due to the circumferential non-uniformity of the material mechanical properties based on the numerical analysis of their three-dimensional stress-strain state. It is shown that this non-uniformity can be one of the causes for the occurrence and development of progressive creep deflection of high-temperature rotors that have been in long-term operation and also their bending in case of excess of the rated rotational speed.

Savchenko K. V., *Zinkovskii A. P.*, *Tokar' I. G.*, *and Kruglii Ya. D.* **Effect of Contact Surface Orientation of End-Winding Shelves on Static Stressed State of Operating Turbine Blades** // Problems of Strength. – 2014. – No. 4. – P. 62–72.

We provide the numerical simulation results on the variation of characteristics of static stressed state of turbine blades versus inclination angle of shelves' contact surfaces to the rotation plane of the blade wheel with account of action of the field of centrifugal forces and high temperatures of the gas flow.

Bobyr' N. I., *Babenko A. E.*, *Lavrenko Ya. I.*, *and Khalimon A. P.* **Durability of Centrifuge Structural Components with Account of Their Damageability** // Problems of Strength. – 2014. – No. 4. – P. 73–83.

We propose a new technique for calculation and assessment of the current state of heavy-duty structural elements under low-cycle fatigue in view of the operating mode specific features. The technique is based on the concept of dispersed damageability and the account of damage parameter in the system of governing equations on example of high-speed rotating components of laboratory centrifuges. Macro- and microstructural analyses of the material are performed , as well as static and cyclic tests of 7075 (V95) aluminum alloy. The results of experimental studies are compared with theoretical calculations by the finite element method via the ANSYS software package.

Muzyka N. R. and Shvets V. P. **Determination of Stresses and Strains in Elastoplastic Deformed Body from Hardness Characteristics** // Problems of Strength. – 2014. – No. 4. – P. 84–91.

The paper considers the possibility of determining stresses and strains in elastoplastic deformed body from hardness spreading parameters.

Sajikumar K. S., *Asok Kumar N.*, *and Nageswara Rao B.* **Application of the Point Stress Criterion to Assess the Bond Strength of a Single-Lap Joint** // Problems of Strength. – 2014. – No. 4. – P. 92–101.

Finite element analysis has been carried out to obtain the interfacial stresses in a single lap joint using a special 6-node isoparametric element for adhesive layer. The analysis results are found to be in good agreement with the closed-form solution of Goland and Reissner. The peak normal and shear stresses found in the adhesive layer at the edges of the joint are due to stress singularity. The bond strength of the single-lap joint is estimated considering one of the stress fracture criteria known as the point stress criterion. Bond strength estimates are found to be reasonably in good agreement with existing test results.

Li Y. **Development of Strength and Yield Criteria Based on the Relationship between Elastic and Plastic Strains** // Problems of Strength. – 2014. – No. 4. – P. 102–108.

The presented research results imply a certain relationship between elastic and plastic parts of strain. Based on the preliminary summary of this relationship, a new strength criterion is proposed, which can be treated as modification of the maximum principal strain criterion. Since the proposed approach establishes a relationship between strength and yield criteria, it can also be treated as a new yield criterion.

Torabi H. and Shariati M. **Buckling Analysis of Steel Semi-Spherical Shells with Square Cutout under Axial Compression** // Problems of Strength. – 2014. – No. 4. – P. 109–122.

Buckling of steel thin walled semi-spherical shells with square cutout due to axial compressive loads has been studied by numerical simulations, and results were compared with those from the experiments. Three vertical compression loadings were applied to specimens using the following methods: a rigid flat plate and a rigid bar with circular and spherical cross sections. The main aim of this study is to determine the influence of the cut out size-to-location (a/H) and the thickness-to-diameter (t/D) on the mean collapse load of the semi-spherical shells. The finite element models were analyzed using ABAQUS nonlinear buckling analysis and the experimental tests were performed using an INSTRON 8802 servo-hydraulic machine. Finally, the different results obtained using the two analysis methods were compared. The comparison reveals that experimental and numerical nonlinear model results match closely with each other.

Mokaddem A., *Alami M.*, *Doumi B.*, *and Boutaous A.* **Prediction by a Genetic Algorithm of the Fiber–Matrix Interface Damage for Composite Material. Part 1. Study of Shear Damage in Two Composites T300/914 and PEEK/APC2** // Problems of Strength. – 2014. – No. 4. – P. 123–129.

We have conducted research on the effect of fiber arrangement on the optimization of the damage to the interface, recently published. We develop in this paper the evolution of the damage in the shearing direction by genetic algorithm. The results obtained by varying the shear rate of the interface of the two materials studied T300 and PEEK, show a good agreement between our genetic approach and the mathematical models presented by Cox and Weibull.

Mokaddem A., *Alami M.*, *Ziani N.*, *Beldjoudi N.*, *and Boutaous A.* **Prediction by a Genetic Algorithm of the Fiber–Matrix Interface Damage for Composite Material. Part 2. Study of Shear Damage in Graphite/Epoxy Nanocomposites** // Problems of Strength. – 2014. – No. 4. – P. 130–135.

The objective in this paper is to apply the same genetic model as applied in Part 1 to optimizing the shear damage to the fiber–matrix interface of nanocomposite material graphite epoxy. The results show good agreement between the numerical simulation and the actual behavior of the material chosen composite and nanocomposites, and these results are similar to results obtained by processing techniques expanded graphite reinforced polymer nanocomposites made by Asma Yasmine. These results were confirmed by calculating the rate of damage with a genetic simulation.

Levchuk S. A. **Application of Potential Theory Methods for Static Deformation Studies on Sectional Cone Shells** // Problems of Strength. – 2014. – No. 4. – P. 136–141.

The static deformation problem for cone shells is examined. The solution is built on potential theory methods. An examined body is treated as the sectional structure, including several cone shells. The conditions of shell connection in the sectional structure are formulated. For the examined problem, the Green-type matrix is constructed. Basic stress state characteristics of a sectional cone shell in relation to cone angles are investigated.

Shvab'yuk V. I., *Rotko S. V.*, and *Uzhegova O. A.* **Bending of a Composite Beam with a Longitudinal Cut** // Problems of Strength. – 2014. – No. 4. – P. 142–151.

Within the framework of the composite beam theory, an analytical solution is obtained for a beam with a longitudinal cut, which is collinear to its median line. The beam bending loading results in the cut opening. The elementary formulas for stresses and displacements of all beam sections are derived. The accuracy of the results obtained is confirmed by their comparison with the respective data derived by solving the elastic theory plane problem by the method of boundary elements.

Bazhenov V. A., *Luk'yanchenko O. O.*, *Kostina O. V.*, *and Gerashchenko O. V.* **Probabilistic Approach to Reliability Assessment of the Imperfect Shell Support** // Problems of Strength. – 2014. – No. 4. – P. 152–161.

A probabilistic approach to reliability assessment of the imperfect cyclindrical shell support by stability is proposed. The nonlinear resistance of the shell is assessed, in view of its imperfect geometry, under action of combined loading. The critical load combination surface is constructed and the stable zone is specified. The reliability by strength is calculated with account of different types of distribution of the imperfection probability density and its preset maximal value using the obtained reliability surface. The acceptable combinations of combined loads are obtained, which should be taken into account in the design and operation calculations of the shell support under study.

Semegen O. M., *Odosii Z. M.*, *and Kustov V. V.* **Study and Simulation of the Effect of Design and Technological Parameters of Toothed Roller Bits on Wear Resistance of Their Tipped Cladding Surfaces** // Problems of Strength. – 2014. – No. 4. – P. 162–171.

For assessment of the effect of design and technological parameters of toothed roller bits on wear resistance of their tipped cladding surfaces during the drilling process, tests on a specially developed bench are performed. Based on the test results, mathematical models are obtained, which describe the effect of these parameters on wear characteristics of tipped teeth surfaces of the toothed roller bits produced by various cladding schemes. It is shown that the optimal cladding scheme is provided by using the "relite" tungsten carbide-based powder and a larger cladding area by the tooth width.