Abstracts

Hudramovich V. S., *Hart E. L.*, *Klimenko D. V.*, *and Ryabokon' S. A.* **Mutual Influence of Openings on Strength of Shell-Type Structures under Plastic Deformation** // Problems of Strength. – 2013. – No. 1. – P. 5–16.

Analytical models have been constructed for the stress-strain determination by using projection-iterative schemes for implementation of the finite-element method for shell-type structures with rectangular openings under plastic deformation. The variation of opening parameters, their number, and spacing between them allows one to study the formation and transformation of plastic strain zones in the course of loading for various deformation curves. Merging of the zones leads to stiffness reduction, which fact is used in predicting the load-carrying ability of shell-type structures with openings.

Lepikhin P. P., *Romashchenko V. A.*, *and Bakhtina E. V.* **Methods and Results of the Analysis of Stress-Strain State of Multilayered Anisotropic Cylinders under Dynamic Loading Conditions (Survey). Part 1. Experimental Studies** // Problems of Strength. – 2013. – No. 1. – P. 17–32.

We present the analysis of known from literary sources methods and results of experimental study of stress-strain state and strength of multilayered thick-walled anisotropic cylinders under dynamic loading conditions.

Skal's'kyi V. R., *Rudavs'kyi D. V.*, *and Dubyts'kyi O. S.* **Residual Resource Calculation of Carriage Spring Sheet with a Surface Crack** // Problems of Strength. – 2013. – No. 1. – P. 33–42.

Residual resource calculation technique is proposed for truck carriage spring sheet with half-elliptical crack under cyclic loading with account of operation time. The technique is based on calculation model of fatigue crack propagation using the energy-based fracture mechanics criterion. Calculation results on residual life of carriages pring sheet for various values of its mechanical characteristics are analyzed.

Tsybanev G. V. **Application of Deformation-Based Criterion for Description of Propagation Behavior of Short Fatigue Cracks** // Problems of Strength. – 2013. – No. 1. – P. 43–52.

Equations describing dependences between parameters of deformation-based fatigue curve and parameters of propagation of short surface cracks for limited fatigue lives are taken from literary sources. The dependence between the initial defect size and average grain size in the high-cycle fatigue range is introduced. Fatigue curves calculated using the proposed dependences and the criterion of propagation of a surface crack of length 100 μm are in good correlation with the available experimental results for steels 45, 12KhN3A and 40Kh. Such close fit indicates a possibility for calculation-and-experimental determination number of cycles before initiation of a short crack, thus avoiding its length direct measurement during tests.

Shcherbakov S. S. **Spatial Stress-Strain State of Tribofatigue System in Roll-Shaft Contact Zone** // Problems of Strength. – 2013. – No. 1. – P. 53–63.

We consider the mechanical-and-mathematical model of stress-strain state system subjected to action of contact and non-contact loads. The stressed state is derived by superposition of stress fields induced by normal and tangential contact loads with elliptic distribution, as well as by non-contact bending. A significant change of the system stress-strain state, as compared to purely contact problem solution, is demonstrated.

Herasymchuk O. M. and Kononuchenko O. V. **Model for Fatigue Life Prediction of Titanium Alloys. Part 1. Elaboration of a Model of Fatigue Life Prior to Initiation of Microstructurally Short Crack and a Propagation Model for Physically Short and Long Cracks** // Problems of Strength. – 2013. – No. 1. – P. 64–79.

We discuss models of fatigue life at the first and second stages of fatigue fracture. Based on modification of these models, we propose a model which allows one to predict residual life to fracture under conditions of high-cycle uniaxial loading of smooth specimens from titanium alloys.

Pokrovskii V. V. and Sidyachenko V. G. **Effect of Mode I and II Thermomechanical Preloading on the Fracture Toughness of Heat-Resistant Vessel Steels** // Problems of Strength. – 2013. – No. 1. – P. 80–90.

The paper presents results of experimental investigations to assess the effect of Mode I and II thermomechanical preloading on the crack resistance of specimens in four-point bending tests. Specimens were subjected to Mode I and II repeated loading. The investigations were carried out on heat-resistant reactor steels. An algorithm for the numerical assessment of fracture toughness with allowance for thermomechanical preloading under mixed loading conditions is proposed.

Muzyka N. R., Shvets V. P., and Makovetskii I. V. **Damage Estimation of Recrystallyzed Metal during its Further Deformation** // Problems of Strength. – 2013. – No. 1. – P. 91–100.

Applicability of the LM-hardness method for the metal state estimation during thermomechanical loading is demonstrated. The degree of the metal initial plastic deformation effect on its damageability is estimated depending on the deformation level during its further deformation after recrystallization using data on scatter of mass values of hardness characteristics. It is shown that, in prestrained metal which had been subjected to recrystallization, accumulation of metal structure damages occurs simultaneously with grain size reduction and increase in hardness. Preliminary plastic deformation prior to annealing strongly affects accumulation of damages in metal: higher is its pre-annealing level, more active is damage accumulation during deformation of metal specimens after annealing.

Manevich A. I., *Ponomarenko E. A.*, *and Prokopalo E. F.* **Stability of Orthotropic Cylindrical Shells Sublected to Bending by a Transverse Force. Part 1. Theory** // Problems of Strength. – 2013. – No. 1. – P. 101–111.

Using “LIRA” software program complex, we study the stability problem of isotropic and orthotropic cylindrical shells subjected to bending by a transverse force. The parametrical analysis of the solution obtained is performed and the accuracy of available approximated estimations of the force critical value is determined.

Pogrebnyak A. D., *Regul'skii M. N.*, *and Zheldubovskii A. V.* **Estimation of Stress Concentration Effect on Fatigue Resistance of Structural Materials during Asymmetric Cyclic Loading** // Problems of Strength. – 2013. – No. 1. – P. 112–127.

Calculation-and-experimental estimation of sensibility of structural materials to stress concentration under conditions of high-cycle axisymmetric loading by tension–compression, bending and torsion is performed. The proposed limiting state model is applied to solving this problem. An adequate correlation of the calculated results with the experimental data is obtained.

Kucher N. K., *Prikhod'ko R. P.*, *and Borovik O. V.* **Prediction of Creep and Long-Term Strength of Materials during Nonisothermal Deformation Processes** // Problems of Strength. – 2013. – No. 1. – P. 128–139.

A model for description of unidimensional nonisothermal processes of long-term deformation with account of the material damage accumulation is presented. Stress and temperature influence on variation of creep deformation rate is accounted for via a scalar function of damage accumulation. The effectiveness of this approach for description of creep behavior of 12Cr–18Ni–Mo steel is shown for relatively wide ranges of operating stresses and temperatures.

Ghorbanpour Arani A., *Haghshenas A.*, *Amir S.*, *Mozdianfard M. R.*, *and Latifi M.* **Electro-Thermo-Mechanical Response of Thick-Walled Piezoelectric Cylinder Reinforced by Boron-Nitride Nanotubes** // Problems of Strength. – 2013. – No. 1. – P. 140–158.

Electro-thermo-elastic stress analysis of piezoelectric polymeric thick-walled cylinder reinforced by boron-nitride nanotubes (BNNTs) subjected to electro-thermo-mechanical fields is presented. The electro-thermo-elastic properties of piezoelectric fiber reinforced composite (PEFRC) was studied by a modified XY micromechanical model capable of exhibiting full coupling relation between electric, thermal and elastic fields. Assuming PEFRC material and its composite constituents to be linear, homogenous, orthotropic, and perfectly bonded with uniform applied field, the basic relation for the axisymmetric deformation of a thick-wall cylinder subjected to uniform internal and external pressures, an axial electrical load, a temperature change between inner and outer radius are derived. Although the cylinder has end caps and is free to change length, displacement, strains, and stresses at location far removed from the end caps have been investigated. The stress results suggest that increasing BNNTs content in longitudinal direction reduces the effective stress. Displacement along radial direction indicates an optimum content of 5% BNNT for this.

Furthermore, at normal working conditions, the influence of thermal and mechanical fields are much higher than the electric one on the effective stress; hence, this smart structure is best suited for applications as sensors than actuators.

Moltasov A. V. **Application of Nonplanar Sections' Technique for Stress Estimation in Stress Concentration Zones Induced by Butt Weld Strengthening** // Problems of Strength. – 2013. – No. 1. – P. 159–167.

A butt weld stress estimation technique based on the assumption of nonplanar sections is substantiated. Analytical relationships describing variation of normal stresses in stress concentration zones (both along the contour, and by joints depth) are derived. For a point with the maximal stress concentration an equation for stress concentration factor is obtained. Stress concentration factor calculation results are compared with those taken from literary sources. The equations for determination of stress gradient in an arbitrary point of a section located in the stress concentration zone, as well as relative stress gradient in a point with the maximal stress concentration, are presented.