Torabi A. R. and Berto F. **Fracture Assessment of Blunt V-Notched Graphite Specimens by Means of the Strain Energy Density** // Problems of Strength. – 2013. – No. 6. – P. 5–21.

The main aim of the present work is to check the suitability of the brittle fracture model, namely the local strain energy density (SED), in predicting the experimental results on mode I fracture of blunt V-notched graphite components. For this purpose, a wide range of test results reported in the recent literature on brittle fracture of V-notched test specimens characterized by different geometries is considered. The specimens are made of the same type of coarse-grained polycrystalline graphite. The fracture assessment is carried out predicting theoretically the fracture loads by means of the SED criterion. The SED parameter is evaluated by averaging the local energy over a well-defined control volume which embraces the notch edge. It is found that the SED criterion allows assessing the fracture behavior of graphite specimens characterized by different notch angles and tip radii.

Hariri-Ardebili M. A. and Mirzabozorg H. **Orthotropic Material and Anisotropic Damage Mechanics Approach for Numerically Seismic Assessment of Arch Dam–Reservoir–Foundation System** // Problems of Strength. – 2013. – No. 6. – P. 22–44.

In contrast with modeling of the contraction joints, the performance and influence of lift joints are usually neglected in numerical analysis of concrete arch dams. In this paper, the seismic nonlinear response of a concrete arch dam–reservoir–foundation system is investigated with considering the effects of lift joints using orthotropic-based material. An anisotropic damage mechanics approach is introduced and modified to take into account the effects of weak horizontal planes between concrete lifts during the construction phase. This model is capable to consider the pre-softening behavior, the softening initiation criterion and anisotropic cracking behavior in mass concrete. The coupled equation of motion in dam–reservoir system is solved by staggered displacement method while the foundation rock is assumed as a mass-less and rigid mediums. The coupled system is excited using three-component ground motion in the maximum credible level. It is found that using orthotropic-based material increases crest displacements and also leads to more damage in the dam body in comparison with the case using the common isotropic-based material.

Czechowski L. and Kowal-Michalska K. **Static and Dynamic Buckling of Rectangular Functionally Graded Plates Subjected to Thermal Loading** // Problems of Strength. – 2013. – No. 6. – P. 45–55.

In the paper, the buckling phenomenon for static and dynamic loading (pulse of finite duration) of functionally graded plates subjected to uniform temperature increment is presented. The work deals with thin rectangular plates with unmovable edges, simply supported or clamped along all edges. The material properties varying smoothly across the thickness are assumed to be temperature-independent. The investigations are conducted for different values of volume fraction index and uniform temperature rise in form of rectangular pulse of finite duration.

Alfred Franklin V. and Christopher T. **Generation and Validation of Crack Growth Resistance Curve from DCB Specimens: An Experimental Study** // Problems of Strength. – 2013. – No. 6. – P. 56–68.

This article examines fracture toughness and interlaminar failure load of double cantilever beam (DCB) specimens made of glass/epoxy of three different lay-ups. The present model requires the applied load–displacement history and crack extension to generate the crack growth resistance curve (*R*-curve). From the generated *R*-curve, the interface failure load was estimated for the specimens and good agreement with the experimentally recorded value was found.

Naveed Afzal, Tariq Shah, and Ahmad R. **Microstructural Features and Mechanical Properties of Artificially Aged AA2024** // Problems of Strength. – 2013. – No. 6. – P. 69–81.

Microstructural features and mechanical properties of Al–Cu–Mg alloy (AA2024) were examined after aging the alloy between 105–195℃ for various durations. One set of the specimens was aged at 105, 135, 165, and 195℃ for 2 h, whereas the aging of other set of specimens at these temperatures was performed for 3.5, 3, 2.5, and 2 h, respectively. X-ray diffraction and

scanning electron microscopy results indicated the formation of *S*- (Al_2CuMg) and Θ- (Al_2Cu) phase precipitates whose density and size changed with aging time and the temperatures. Anomalous variations in yield strength, ultimate tensile strength, plastic elongation, elastic modulus and hardness were observed with either changing the aging temperature, or the time. However, the specimens aged at 135 and 195℃ for 2 h displayed the maximum strength and hardness along with a slight decrease in their plasticity as compared to those aged at other temperatures with various durations.

Ismail A. A. **Estimating the Generalized Exponential Distribution Parameters and the Acceleration Factor under Constant-Stress Partially Accelerated Life Testing with Type-II Censoring** // Problems of Strength. – 2013. – No. 6. – P. 82–94.

Accelerated life testing (ALT) and partially accelerated life testing (PALT) are frequently used in modern reliability engineering. ALT and PALT are run to obtain information on the life of the products and materials in a shorter time and at lower cost. The experimental units are subject to stress conditions that are more severe than those encountered in normal use condition to induce early failures. ALT or PALT can be carried out using constant, step, progressive, cyclic and random stress loadings. This paper considers the problem of estimating the generalized exponential (GE) distribution parameters and the acceleration factor under constant-stress PALT model. The main objective is to derive the maximum likelihood estimators (MLEs) of the parameters of the GE distribution and the acceleration factor when the data are type-II censored from constant-stress PALT. Also, the performance of the MLEs is investigated numerically for different sample sizes and different parameter values using the mean square error. In addition, the approximate confidence intervals of the model parameters are constructed. Moreover, the likelihood ratio bounds (LRB) method is used to obtain confidence bounds of the model parameters when the sample size is small. For illustration, a simulation study is conducted. It is observed that the simulation results support the theoretical findings.

Rostamiyan Y., Fereidoon A. B., Omrani A., and Ganji D. D. **Preparation, Modeling, and Optimization of Mechanical Properties of Epoxy/HIPS/Silica Hybrid Nanocomposite Using Combination of Central Composite Design and Genetic Algorithm. Part 2. Studies on Flexural, Compression, and Impact Strength** // Problems of Strength. – 2013. – No. 6. – P. 95–111.

In spite of good tensile strength of epoxy resins, they have brittle nature and show poor resistance to crack propagation. In view of enhancing mechanical strength and fracture toughness of epoxy-based nanocomposite simultaneously, a new combination of thermoplastic and particulate nanofiller is used as a modifier. Here, the obtained ternary epoxy-based nanocomposite includes high impact polystyrene (HIPS) as thermoplastic and silica nanoparticles as its particulate phases. Flexural, compression and impact were the three different mechanical tests investigated, in order to achieve higher strength without attenuating other desired mechanical properties. Central composite design (CCD) is employed to present mathematical models to predict mechanical behaviors of epoxy/HIPS/silica nanocomposite as a function of physical factors. The effective parameters investigated were HIPS, SiO_2 and hardener contents. Based on mathematical functions obtained from CCD model, the genetic algorithm – as one of the most powerful optimization tools – is applied to find the optimum values of mentioned mechanical properties. We have found that a combination of HIPS and silica nanoparticles significantly increase compressive and impact strengths of epoxy resin up to 57 and 421%, respectively. Although flexural strength did not change positively, the elongation at break for flexural one increased up to 144%. Finally, the morphology of fracture surface was studied by energy-dispersive X-ray spectroscopy and scanning electron microscopy.

Buyukkaragoz A., Kalkan I., and Lee J. H. **A Numerical Study of the Flexural Behavior of Concrete Beams Reinforced with AFRP Bars** // Problems of Strength. – 2013. – No. 6. – P. 112–129.

In this study, analytical and numerical investigations were extensively conducted to evaluate the flexural behavior of concrete beams reinforced with aramid fiber-reinforced polymer (AFRP) rebars. The AFRP-reinforced concrete beams were analyzed using the separated finite element method containing different elements for concrete and reinforcement. In addition, this study used two different effective moment of inertia expressions to estimate the load-deflection responses and the service-load deflections of the beams. The service-load deflections of the AFRP-reinforced concrete beams obtained from

the finite element analysis were in close agreement with those from the effective moment of inertia expressions. The numerical ultimate moments also correlated well with the analytical values of concrete stress-strain models. Numerical analyses, which hardly predict the sudden reduction in the flexural rigidity of FRP-reinforced concrete beams due to the crushing of cover concrete, were shown to provide somewhat conservative deflection estimates.

Cheraghi H., Ghasemi F. A., and Payganeh G. **Morphology and Mechanical Properties of PP/LLDPE Blends and Ternary PP/LLDPE/ nano-$CaCO_3$ Composites** // Problems of Strength. – 2013. – No. 6. – P. 130–141.

Mechanical and morphological properties of polypropylene (PP)/linear low density polyethylene (LLDPE)/ nano-sized calcium carbonate ternary composites were prepared using a twin-screw extruder. Modification of the filler nano-particle surface was pretreated with stearic acid and of the PP/LLDPE interface by melting high crystallizable, high density polyethylene. In this research, effects of modified linear low density polyethylene (LD) and nano-$CaCO_3$ weight percentage on tensile strength, Young's modulus and impact absorbed energy of composites were investigated. In addition, effect of the interaction between filler particles and polymer matrix was studied. Effect of quantity of microcracks on tensile properties of the composites was also discussed. Effect of nano-$CaCO_3$ and LD on the quantity of microcracks and impact-fractured surface of PP composites was studied by scanning electron microscope (SEM). The impact-fractured surface morphologies were characterized by SEM to clarify the possible mechanisms for improving the fracture resistance.

Temimi Lahouari H., Allel M., Belkaid N., Boutaous A., and Bouamrane R. **Study of the Effect of Water Intake by the Matrix on the Optimization of the Fiber Matrix Interface Damage for a Composite Material by Genetic Algorithms** // Problems of Strength. – 2013. – No. 6. – P. 142–151.

The objective of this paper is study the influence of the matrix swelling due to water on the damage of the fiber matrix interface of a composite material. The results obtained by a genetic approach based on Weibull probabilistic model, show good agreement between the simulation and the actual behavior of the two materials T300/914 and PEEK/APC2. Also the absorption of water by the matrix increases significantly the interface damage.

Kashyzadeh K. R. and Arghavan A. **Study of the Effect of Different Industrial Coating with Microscale Thickness on the CK45 Steel by Experimental and Finite Element Methods** // Problems of Strength. – 2013. – No. 6. – P. 152–163.

This article is aimed at analyzing the effects of industrial coatings of hardened chromium, trim chromium, hardened nickel and warm-galvanization with a thin structure and dimensions in micron scale, on fatigue endurance limit of components. In order to do this, using the plating process and the analyzed coatings with the thickness of 13 and 19 μm under the operation conditions, the components of CK45 steel were plated. An attempt was made to analyze the fatigue of components by modeling the interface phase between the base metal and coating more accurately, using the linear spring elements. The *S–N* curves obtained via the proposed finite element model (including 3 different phases) and other finite element models in which the shell element was used to model the intermediate phase, are compared to the experimental results. The findings indicate that, considering the difference between the *S–N* curves constructed via the present finite element model and via test results, this model is improved in comparison to the earlier one, and yields more reliable results. Taking into account the environmental and operating conditions of components, the galvanized coating is the most appropriate among low-thickness coatings, but with significant increase in coating thickness, the best choice becomes hardened chromium coating. Increase in coating thickness by 6 μm reduces the fatigue limit by 14.96 and 4.37% for galvanized and hardened chromium coatings, respectively.