Ya. M. Grigorenko, A. Ya. Grigorenko, L. I. Zakhariichenko

SOLUTION OF PROBLEMS AND INVESTIGATION OF STRESS STATE OF NONCIRCULAR CYLINDRICAL VARIABLE THICKNESS SHELLS ON SPLINE-APPROXIMATION BASE

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A non-standard approach is proposed for solution of two-dimensional boundary-value stress-strain problems for closed and open variable thickness cylindrical shells with arbitrarily fixed ends under non-uniformly distributed and local loadings. The approach is based on the spline-approximation of the solution in one coordinate direction and solving the one-dimensional boundary-value problem by the stable numerical method of discrete orthogonalization. The results obtained are presented in the form of plots and tables.

V. T. Grinchenko, N. S. Gorodetska

METHOD OF SUPERPOSITION AS APPLIED TO BOUNDARY-VALUE PROBLEMS IN NON-REGULAR WAVEGUIDS

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The method of superposition has been developed for solving the boundary problems of the dynamic elasticity theory. There are local power singularities of stress field. The exponent of such singularities is defined a priori on the basis of the general properties of stress fields in elastic bodies in the presence of angular points on the boundary. The connection between asymptotic properties of the unknown coefficients of algebraic system corresponding to the boundary problem and local singularity at angular point has been found. The boundary problem for non-regular waveguide has been considered. The existence of the connection is used for development of effective algorithm for obtaining the quantitative estimations of characteristics of the wave fields. The proposed method can be used for solving a wide class of problems of mathematical physics.

A. F. Ulitko, M. A. Morgunov

INVESTIGATION OF CONTACT STRESSES IN THIN ELASTIC STRIP UNDER BENDING

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Both the exact solution of the smooth contact between a rigid disc and a thin elastic strip under the specified external loads and the corresponding approximate solution based on the Hertz – Timoshenko theory has been constructed. The dynamics of changes of contact stresses depending on increasing the magnitude of the force for this problem has been investigated. Comparison of both solutions shows high accuracy of the approximate solution. This validates the advisability of using the Hertz – Timoshenko hypothesis in contact problems dedicated to thin-walled elastic substrates. It has been shown that under sufficiently large magnitudes of applied force a strip is undergoing tearing off from the stamp in the center of contact zone.

S. A. Ambartsumian, M. V. Belubekyan

ON GEOMETRICALLY NON-LINEAR PROBLEMS OF TRANSVERSALLY ISOTROPIC PLATES UNDER TANGENTIAL FORCES

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Based on assumptions of the theory of anisotropic plates, averaging the equations of elasticity theory, the governing stability and bending equations are obtained for geometrically non-linear transversally isotropic plates under action of tangential forces.

V. V. Meleshko, G. J. F. van Heijst

MIXING OF VISCOUS FLUID IN RECTANGULAR CAVITY

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This paper addresses the classical two-dimensional biharmonic problem for a rectangular domain. The method of superposition is effective for solving the mechanical problems concerning creeping flow of viscous fluid set up in a rectangular cavity by tangential velocities applied along its walls. The method is illustrated by several examples.

Yu. V. Nemirovsky, A. P. Yankovsky

DYNAMIC VISCO-PLASTIC BENDING OF REINFORCED CORES WITH VARIABLE CROSS-SECTION

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We present a visco-plastic model within the limits of which the problem on non- elastic dynamic bend of cores is formulated. The method of numerical integration of the problem in view, based on generalization of the Runge – Kutta methods is developed. Comparison of numerical results with the known analytical solutions obtained within the limits of a rigid-plastic of model is made, their good agreement is shown. Efficiency of the developed approach is shown on the calculations of non-elastic dynamics of the isotropic and reinforced cores of constant and variable cross-section. It is shown, that not always the optimum – at static loading – cores are the best at dynamic influence.

A. A. Zolochevsky, V. L. Rvachev, S. N. Sklepus

CREEP OF NON-CANONICAL FORM PLATES FROM MATERIALS WITH NON-SYMMETRIC PROPERTIES

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A creep problem for thin plates of complex form from materials with non-symmetric properties under plane loading is considered. The method of solution is based on the joint using the variational-structural method and the Runge – Kutta – Merson method. The structures of solution for the main types of boundary conditions are obtained. The influence of loading type on creep behavior and long-time strength of the plate with holes is studied.

Ya. Yo. Burak, O. R. Hachkevych, R. S. Musiy

THERMOELASTICITY OF NON-FERROMAGNETIC ELECTROCONDUCTING SOLIDS UNDER INFLUENCE OF PULSE ELECTROMAGNETIC FIELDS

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A mathematical model for description and methodology for definition of thermo-stressed state of non-ferromagnetic solids which are influenced by external non-stationary electromagnetic fields of impulse type, which are widely used in engineering praxis, are presented. This model is the development of well-known models for quasi-stationary and impulse electromagnetic fields. As example, thermo-mechanical behavior of continuous and hollow cylinders during such influence is considered.

V. G. Karnaukhov, V. I. Kozlov, V. M. Sichko

MONOHARMONIC APPROXIMATION IN PROBLEMS OF NONLINEAR VIBRATIONS AND DISSIPATIVE HEATING OF INELASTIC BODIES

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 85-103. – Ref.: 57 names. – Ukr.
The question about one-frequency vibrations and dissipative heating of inelastic bodies under monoharmonic loading is considered using the nonlinear models of inelastic materials, finite-element method and analysis of numerical results.

V. F. Chekurin

MODEL OF INTERPENETRATING CONTINUA AND THERMODYNAMICS OF DEFORMATION OF SEMICONDUCTORS

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 104-115. – Ref.: 31 names. – Ukr.
Within the framework of the model of interpenetrating continua using the concepts of the zone theory of conductivity of solids the basic thermodynamic relations for semiconductors doped by donor and acceptor impurities have been obtained. On this bases the parameters of local thermodynamic state corresponding to the processes of deformation, thermal conductivity, electric conductivity and free current carriers generation-recombination have been established.

A. V. Komarov, V. V. Loboda

ON MOVING IMPERMEABLE INTERFACE CRACK WITH CONSTANT SUBSONIC VELOCITY IN PIEZOELECTRIC BIMATERIAL

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 116-130. – Ref.: 14 names. – Ukr.
A problem for an impermeable crack moving along the interface of two dissimilar piezoelectric materials is considered. A mechanically frictionless and electrically permeable contact zone is assumed at the right crack tip whilst another part of the crack is open. The crack moves with constant velocity together with concentrated loading and electrical charge, which are prescribed at the crack faces. The transcendental equation for determination of the real contact zone length is solved numerically, and both stress and electrical displacement intensity factors are derived. Special attention is devoted to the problem of the energy release rate at the right crack tip. A comparative analysis is given for a finite length crack and for a semi-infinite crack.

D. V. Hrylits'kyj, G. T. Sulym, B. S. Bilan

STATIC THERMOELASTIC EQUILIBRIUM OF TWO-LAYER m -GON PIPE AT COMPRESSION AND CONTACT HEATING

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 131-145. – Ref.: 8 names. – Ukr.
The formulation and corresponding approximate solution to the plane static boundary contact thermoplastic problem for two-layer m -gon tube is presented. It is assumed that a cylindrical system is under the temperature field and given normal stresses which are uniformly distributed on the lateral surfaces. The mechanical and thermophysical properties of materials are temperature-independent. The internal tube is circular axially symmetric, the external surface of external tube has the form of m -angle with rounded angles. The problem is solved by the method of small parameter with regard for three-order terms.

V. L. Bogdanov

ON INVESTIGATION OF AXIALLY SYMMETRIC PROBLEMS OF LINEARIZED FRACTURE MECHANICS FOR A SOLID CONTAINING TWO PARALLEL CRACKS

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 146-154. – Ref.: 10 names. – Russian.
In this paper the problems for two parallel penny-shaped cracks in an infinite solid are considered. The analysis involves two non-classical mechanisms of fracture, namely, the fracture of solids with initial (residual) stresses and fracture of materials under compression along the cracks. Statement of the problems is formulated and the Fredholm second-kind integral equations are obtained. The representations of the stress intensity factors for the cracks under tension are given.

R. M. Kushnir, M. M. Nykolyshyn, M. Yo. Rostun

ELASTICO-PLASTIC SPHERICAL SHELL WITH A SYSTEM OF ARBITRARILY LOCATED CRACKS

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 155-163. – Ref.: 17 names. – Ukr.
The problem on limit equilibrium of a spherical shell with arbitrarily located rectilinear (in plane) through cracks is reduced to a system of singular integral equations. The system is solved numerically under the boundedness conditions for forces and moments near the cracks and plasticity conditions for thin shells. As an example the shell with four cracks is analysed.

R. M. Martynyak, B. S. Slobodyan

INTERACTION OF TWO BODIES IN CASE OF CAPILLARIES IN INTERCONTACT GAP

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 164-173. – Ref.: 16 names. – Ukr.
Interaction of elastic half-spaces in the case of an intercontact gap, caused by a coulisse on the surface of one of the bodies, incompressible liquid forming meniscuses on the edges of the gap, and of gas pressure action in its middle part is modelled. At the contact problem definition for such a structure the surface tension of liquid, pressure jump on the verge of the liquid and gas, transformation of the gap and change of the capillaries length at loading are taken into account. The solution to the problem is given through the function of the gap height, and for its determination a singular integral equation solved analytically is obtained. Due to limitation of the solution to singular integral equation and because of preservation of the amount of liquid in the capillaries, a system of transcendent equations is derived for determination of the gap and capillaries lengths. The dependence of the gap length and form on loading, and the dependence of jump pressure in a capillary and gas on the gap length are illustrated.

L. A. Filshtinskii, V. N. Kobzar'

PLANE PROBLEM OF COUPLED THERMOELASTICITY FOR PLATES WITH HOLES

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 174-181. – Ref.: 14 names. – Russian.
The method for solution of two-dimensional inner and outer boundary problems of coupled thermoelasticity is proposed. It is based on the constructed fundamental solutions of the corresponding equations.

J. Kubik, Z. Perkowski

RECIPROCITY THEOREM FOR MECHANICAL PROBLEM IN BRITTLE DAMAGED BODY WITH THERMAL DISTORTION

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 182-187. – Ref.: 11 names. – Engl.
The initial-boundary problem of mechanics is formulated in the paper in an incremental version for a viscoelastic-brittle damaged medium with

thermal distortion. Next, the reciprocity theorem is derived for the stated problem. A way of calculation of the global damage parameter for the body is formulated on the basis of a special case of the theorem. The problem is also illustrated by the numerical example.

M. Yu. Shvajko, M. M. Filkevich

ANALYTICAL AND EXPERIMENTAL STUDY OF DEFORMATION OF STEEL-45 UNDER COMPLEX LOADING

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Potentialities of the sliding theory versions [2, 5] *for description the steel 45 non-monotonous deformation under loading along two-linked trajectories* (*tension-torsion of the thin-walled tube*) *are studied. The advantage of version* [5] *is confirmed confronting the experimental data to the theoretical ones. This advantage becomes apparent both under complex and simple loading, especially within small plastic strains comparable to elastic strains on the yield limit.*

O. P. Piddubniak, N. G. Piddubniak

ANALYSIS OF STRAIN-STRESS STATE OF CIRCULAR CYLINDER ROTATING IN ACOUSTIC MEDIUM WITH NON-CONSTANT ANGULAR VELOCITY

ISSN 0130–9420. Mathematical methods and physico-mechanical fields. – 2006. – 49, No. 1. – P. 198-207. – Ref.: 12 names. – Ukr.

A plane strain-state of an elastic circular cylinder of infinite length rotating about its axis of symmetry with a non-uniform angular velocity is studied. We assumed that the cylinder is surrounded by an ideal compressible non-viscous fluid (gas). The exact solution of this hydro-elasticity problem is obtained applying the Fourier transform over time. Calculations are carried out for the case of rotation the Armco iron cylinder immersed in water. The spectral wave characteristics for the displacements and stresses are analyzed. The conditions of resonance amplitudes intensification of a radial displacement and stress tensor components in an elastic cylinder for the case of monochromatic oscillation of angular velocity are investigated.

V. N. Sushch

DISCRETE MODELS OF OPERATORS GENERATED BY THE YANG – MILLS EQUATIONS ON 4-DIMENSIONAL TORUS

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The discrete analogs of the Yang – Mills equations, of the exterior covariant differential operator, and of the adjoint operator of one are constructed on the combinatorial 4-dimensional torus. Self-adjointness of a discrete analog of the Laplace type operator is proved.