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Russian and Japanese Aerospace Literature

During 1994 the *AIAA Journal* will carry selected abstracts on leading research topics from Russian aerospace literature and, as space permits, from similar Japanese literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features Composite Materials and Structures from Russia and Metal Matrix Materials from Japan.

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Russian Aerospace Literature
This month: *Composite Materials and Structures*

A93-43065 Effective elasticity tensors of disperse composites (Ehffektivnye tenzory uprugosti dispersnykh kompozitov). S. V. KUZNETSOV, *Prikladnaya Matematika i Mekhanika* (ISSN 0032-8235), Vol. 57, No. 1, Jan.–Feb. 1993, pp. 103–109. 17 Refs.

For disperse statistically homogeneous elastic composites, analytical formulas for the correcting tensor and for the effective elasticity tensor are obtained using periodic fundamental solutions. As an example, computation results are presented for a disperse composite with an isotropic matrix characterized by dimensionless elastic parameters.

A93-42403 Bending stability of a cylindrical composite shell with longitudinal stiffness ribs (Ustojchivost' pri izgibe kompozitnoj tsilindricheskoj obolochki s prodol'nymi rebrami zhestkosti). A. V. LOPATIN, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 1, Jan.–Feb. 1993, pp. 169–177. 2 Refs.

An analysis is made of the stability of a cylindrical composite shell with longitudinal ribs loaded by bending moments at its ends. A computational model is developed with allowance for the discrete arrangment of the reinforcing ribs, transverse shear in the shell and in the ribs, and the layered and orthotropic structure of the material. As an example, the critical bending moment is determined for a shell with four longitudinal stiffness ribs arranged in several different patterns.

A93-36800 Optimal design of honeycomb sandwich shell aircraft structures of composite materials (Ratsional'noe proektirovanie trekhsloinykh sotovykh obolochechnykh aviakonstruktsii iz kompozitsionnykh materialov). IU. F. KRASHAKOV and S. M. KHOKHLENKOV, *Stress-strain analysis and optimal design of aircraft structures* (A93-36782 14-39). Moscow, Izdatel'skii Otdel TsAGI, 1992, pp. 157–165. 3 Refs.

Methods for optimizing the design of sandwich composite shells with a honeycomb core are presented using a helicopter tail boom structure as an example. In particular, attention is given to the minimum-mass design using criteria of local and general stability, strength, and stiffness in the presence of structural and technological constraints. The characteristics of two shell structures, one fabricated by the layup method and the other by winding with a varying reinforcement angle, are compared.

A93-16704 Complex mathematical modeling of the interaction of high-temperature two-phase flows with carbon/graphite heat insulation materials (Kompleksnoe matematicheskoe modelirovanie vzaimodeistviia vysokotemperaturnykh dvukhfaznykh potokov s uglegrafitovymi teplozashchitnymi materialami). V. A. BURAKOV, N. A. OBUKHOV, R. K. FAIZULLIN, S. F. SANDU, and S. M. ALATORTSEV, *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 30, No. 5, Sept.–Oct. 1992, pp. 992–1001. 14 Refs.

A new physicochemical model, a numerical algorithm, and a computer program have been developed for calculating the dynamics of cold surface slagging and thermochemical degradation of carbon/graphite heat insulation materials under conditions of the inertial deposition of polydisperse liquid particles of a condensed metal oxide phase during heating and cooling cycles. Results of a numerical study of the effect of the deposition of liquid alumina particles on the nonstationary heating and thermochemical degradation of graphite are reported.

A93-35296 Ways of increasing the reliability of large composite structures using dynamic modeling methods (Puti povysheniia nadezhnosti krupnogabaritnykh konstruktsii iz KM metodami dinamicheskogo modelirovaniia). M. V. ALEKSANOVA, A. I. STANKEVICH, V. I. REZNICHENKO, S. N. KUZNETSOV, and V. A. KOZLOV, *Ensuring the reliability and service life of flight vehicle structures by engineering methods* (A93-35276 13-39). Moscow, Izdatel'stvo Moskovskogo Aviatsionnogo Instituta, 1991, pp. 81–86.

The advantages of using dynamically similar models for optimizing the design of large composite structures are briefly discussed. The development of a dynamically similar model is illustrated for the case of a wing box made of carbon composite elements. The calculated dynamic characteristics of the structure are found to be in good agreement with experimental data, which validates the approach proposed here.

A93-33350 The effective field method in the statics of composites (Metod effektivnogo polia v statike kompozitov). V. A. BURIACHENKO, and V. Z. PARTON, *PMTF - Prikladnaia Mekhanika i Tekhnicheskaia Fizika* (ISSN 0044-4626), No. 5, Sept.–Oct. 1992, pp. 129–140. 37 Refs.

A linearly elastic composite medium is considered which consists of a homogeneous matrix containing a random set of inclusions of arbitrary shape with mechanical properties that are nonuniform over the volume of the inclusions. A solution is presented for the classical problem of estimating the effective moduli and mean stress concentrators at the inclusions. The approach proposed here represents an extension of the effective field method, which has been applied earlier to the case where the mechanical properties of the matrix are identical to those of a reference medium.

A93-31138 Optimization of the balancing process for composite rotors (Optimizatsiia operatsii tekhnologicheskogo protsessa balansirovki sostavnykh rotorov). A. I. IL'IANKOV, and L. G. SHCHAVELEVA, *Progressive fabrication processes in aircraft-engine production* (A93-31126 11-37). Moscow, Izdatel'stvo Moskovskogo Aviatsionnogo Instituta, 1991, pp. 60–70.

An algorithm for optimizing the balancing process for a composite rotor is presented. The optimization criteria used are minimizing the difficulty of the balancing task (number of correction planes and balancing loads) and maximizing the mass correction accuracy in each plane. The principal modules of a computerized system for the automatic control of the balancing operations are briefly described.

A93-26875 Compression of layered orthotropic plates of nonsymmetric structure (Szhatie sloistykh ortotropnykh plastin s nesimmetrichnoi strukturoi). N. S. AZIKOV, and V. V. VASIL'EV, *Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 4, July-Aug. 1992, pp. 157–162.

The problem of the longitudinal bending of a layered orthotropic shell of nonsymmetric structure is analyzed using a nonlinear formulation. A comparison of the solution obtained here with a linear solution demonstrates that the latter correctly describes the actual behavior of the plate at the initial stage of loading only and does not yield the limiting load. The case of a square carbon composite plate is considered as an example.

A93-32193 Characteristics of the design of composite rotors for flight vehicle engines with allowance for flexible balancing (Osobennosti proektirovaniia sostavnykh rotorov DLA s uchetom gibkoi tekhnologii balansirovki). A. I. IL'IANKOV, and L. G. SHCHAVELEVA, *Vibrations, deformations, and strength of flight vehicle engine structures* (A93-32182 12-07). Moscow, Izdatel'stvo Moskovskogo Aviatsionnogo Instituta, 1991, pp. 49–54.

Based on results of theoretical studies, recommendations are given concerning the development of composite rotor designs that allow for the variation of possible residual disbalances. A generalized algorithm for selecting the mass correction method and the number and geometry of balancing loads in an individual correction plane is presented. The maximum permissible value of the initial disbalance is calculated by the maximum-minimum method with allowance for the specified fabrication precision. An illustrative example is presented.

A93-32181 Optimal largest diameter of the helicopter rotor blade (Optimal'nyi naibol'shii diametr nesushchego vinta vertoleta). V. R. MIKHEEV, *Problems in the design of helicopter rotors* (A93-32173 12-05). Moscow, Izdatel'stvo Moskovskogo Aviatsionnogo Instituta, 1991, pp. 60–67. 7 Refs.

The problem of the optimal largest diameter of the rotor blade is examined from a historical perspective. It is noted that, historically, the development of new materials made it possible to increase the optimal maximum diameter of rotors by a factor of 1.5-2. It is expected that the transition to new composite materials will make it possible to increase the rotor diameter to 50-60 m, thus achieving a load-bearing capacity in excess of 100 t while retaining the single-rotor configuration.

A93-18438 A study of the mechanical characteristics of the flywheel as the main component of an inertial mechanical energy storage system on board a space vehicle (Issledovanie mekhanicheskikh kharakteristik makhovika kak osnovnogo elementa IMES na bortu kosmicheskogo apparata). G. S. GOLOVKIN, E. I. STEPANYCHEV, and V. S. RUCHINSKII, Studies on the mechanics of space flight in the light of K.E. Tsiolkovsky's ideas; Lectures Devoted to K.E. Tsiolkovsky's Ideas, 25th, Kaluga, Russia, Sept. 11–14, 1990, Transactions (A93-18420 05-12). Moscow, AN SSSR, Institut Istorii Estestvoznaniia i Tekhniki, 1991, pp. 120–122. 4 Refs.

The mechanical properties of a composite flywheel with compliant spokes are briefly examined as part of research concerned with inertial mechanical energy storage devices for space applications. Results of an experimental study of the stiffness coefficients of the spokes in the radial direction and resonance frequencies of the flywheel provide the basis for formulating material selection criteria and developing technology for fabricating flywheel components.

A93-18267 Mathematical morphology method for analyzing the structure of complementary phases in the preparation of multifunctional composite materials (Metod matematicheskoi morfologii dlia analiza struktury vzaimno dopolniaiushchikh faz pri poluchenii mnogofunktsional'nykh kompozitsionnykh materialov). I. N. DOROKHOV, IU. N. MASEEV, and V. V. KAFAROV, *Rossiiskaia Akademiia Nauk, Doklady* (ISSN 0002-3264), Vol. 323, No. 5, 1992, pp. 885–889. 10 Refs.

An attempt is made to explicitly formulate the system of coupling equations for the characteristics of complementary phases in the preparation of multifunctional composite materials. Using this approach, it is possible to create a convenient formalism for investigating the interaction of structural phase transitions in complementary spaces. This approach can be used for the quantitative analysis of the pressing, hardening, and fracture of composite materials.

A93-15193 Effective parameters of composite strength in conjugate physicomechanical fields (Effektivnye parametry prochnosti kompozitov v sopriazhennykh fiziko-mekhanicheskikh poliakh). V. A. BURIACHENKO and V. Z. PARTON, *PMTF - Prikladnaia Mekhanika i Tekhnicheskaia Fizika* (ISSN 0044-4626), No. 4, July–Aug. 1992, pp. 124–130. 14 Refs.

A method is proposed for constructing the strength surface of composite materials in static conjugate physicomechanical fields. The method allows for field coupling, arbitrary anisotropy of the physicomechanical properties, and shape and orientation of the filler inclusions. The single-point first and second moments of the conjugate fields in medium components are determined using previously proposed methods.

A92-42667 Determination of edge effect regions in layered composites in the presence of filler discontinuities (Opredelenie oblastei kraevykh effektov v sloistykh kompozitakh pri nalichii razryvov napolnitelia). A. N. GUZ', IU. V. KOKHANENKO, and E. S. IAKOVLEVA, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 28, No. 3, March 1992, pp. 14–19. 8 Refs.

The problem of determining edge effects in a layered composite material in the presence of two cracks in adjacent filler layers is analyzed in the context of three-dimensional linearized elasticity using a piecewise homogeneous model of a medium consisting of homogeneous contacting bodies. Particular attention is given to integral characteristics, such as the extension of edge effects and the configuration of the edge effect region, which are determined by using the finite difference method. Edge effect regions are shown for certain ratios of the elastic moduli of the filler and the matrix.

A92-31914 A dielectric composite based on high temperature superconductors (Dielektricheskii kompozit na osnove VTSP). A. M. GRISHIN, N. I. MEZIN, G. S. IAROSH, and N. IU. STAROSTIUK, *Fizika Nizkikh Temperatur* (ISSN 0132-6414), Vol. 17, Nov.–Dec. 1991, pp. 1489, 1490. 2 Refs.

A composite has been prepared using an epoxy matrix and single-phase superconducting powders based on YBa2Cu3O(7-x) ceramic with Tc = 91-93 K. The composite was used to produce strip lines; the microwave characteristics of the lines were measured in the frequency range 8-12 GHz. An analysis of the experimental data shows that small magnetic fields can significantly change the microwave parameters of the strip lines. The dielectric composite can thus be used to produce magnetically controlled microwave components.

A92-31895 A method for the strength analysis of composite structures (Metodika poverochnykh raschetov prochnosti konstruktsii iz kompozitsionnykh materialov). V. D. GRIGOR'EV, A. S. DZIUBA, A. A. IONOV, IU. A. KAMYSHOV, and V. F. KUT'INOV, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 22, No. 3, 1991, pp. 81–91. 5 Refs.

A method for analyzing the stress-strain state and strength of composite structures is proposed which employs multilevel highly accurate finite element models of typical areas of the structures. The models allow for the design characteristics, type, and anisotropic properties of the structural elements and for the presence of manufacturing defects, with a correction for experimental data. As an example, the method is applied to the strength analysis of the large doors of a freight compartment, and good agreement is obtained with experimental data.

A92-31865 Lifting surface design using the principle of passive control of elastic characteristics (Proektirovanie nesushchei poverkhnosti s primeneniem printsipa 'passivnogo' upravleniia uprugimi kharakteristikami). E. K. LIPIN and V. E. TENIAEVA, *TsAGI, Uchenye Zapiski* (ISSN 0321-3439), Vol. 22, No. 1, 1991, pp. 103–106.

Results of an analysis of efficient design schemes of forward horizontal control surfaces are reported. In particular, attention is given to two design approaches, a maximum stiffness design and a flexible design scheme. The elastic deformations of the structure are controlled by varying the number and orientation of the plies of the composite material.

A92-30405 Generation of new harmonics of nonlinear elastic waves in a composite material (Generatsiia novikh garmonik nelinieinikh pruzhnikh khvil' v kompozitnomu materiali). IA. IA. RUSHCHITS'KII and I. A. OSTRAKOV, *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Matematika, Prirodoznavstvo, Tekhnichni Nauki* (ISSN 0868-8052), Oct. 1991, pp. 63–66. 9 Refs.

A solution is presented for the problem of the generation of new harmonics during the passage of a nonlinearly elastic wave through a composite material. The solution allows for the self-interaction of modes and for mode-to-mode interaction. Details of the solution procedure are given.

A92-30404 Stability of the induced nonlinear vibrations of toroidal shells of complex profile (Stiikist' vimushenikh neliniinikh kolivan' torovikh obolonok skladnogo profiliu). V. I. GULIAEV and A. A. KIRICHUK, *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Matematika, Prirodoznavstvo, Tekhnichni Nauki* (ISSN 0868-8052), Oct. 1991, pp. 50–53. 6 Refs.

The stability of the steady-state vibrations of composite toroidal shells consisting of two conical components and two toroidal bands with different cross-section radii is investigated for the case of uniformly distributed harmonic loading using a geometrically nonlinear shell theory. The critical dynamic loads are determined as a function of the frequency of the steady-state vibrations of the shell in the low frequency region and as a function of the shape of cyclically symmetric bifurcations.

A92-27550 Effective parameters of static conjugated physicomechanical fields in matrix composites (Effektivnye parametry statich-eskikh sopriazhennykh fiziko-mekhanicheskikh polei v matrichnykh kompozitakh). V. A. BURIACHENKO and V. Z. PARTON, *Fiziko-Khimich-eskaia Mekhanika Materialov* (ISSN 0430-6252), Vol. 27, July–Aug. 1991, pp. 105–111. 21 Refs.

For a wide class of stationary conjugated fields, the problem of estimating the effective composite parameters is reduced to that of investigating uncoupled fields using structural mechanics methods. The multiparticle method of the effective field is extended to the analysis of static conjugated physicomechanical fields in composites. An illustrative example is presented.

A92-25311 Effect of mechanical layer characteristics on the internal instability of a composite (Vliianie mekhanicheskikh kharakteristik sloev na vnutrenniuiu neustoichivost' kompozita). I. A. GUZ', *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 27, Dec. 1991, pp. 110–114. 10 Refs.

The effect of the mechanical characteristics of the filler and the matrix on the critical deformation of a layered composite is investigated in the context of three-dimensional nonaxisymmetric and plane problems. The analysis is carried out on the basis of the second version of the theory of small subcritical deformations in the three-dimensional linearized stability theory for deformable bodies. Expressions are presented which relate the critical deformation to each of the mechanical properties of the layers.

A92-42766 Torsion of a cylindrical composite shaft of finite length (O kruchenii kompozitsionnogo tsilindricheskogo vala konechnoi dliny). D. IA. BARDZOKAS, A. L. KALAMKAROV, and O. B. RUDAKOVA, *Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 1, Jan.–Feb. 1992, pp. 58–66. 8 Refs.

The problem of the torsion of a multilayer composite hollow cylindrical shaft of finite length is analyzed using the general approach proposed by Ufland (1976). This approach and the averaging method are used to obtain a new generalized integral equation which is then used to obtain an analytical solution for the problem. In the particular case of a homogeneous material, the generalized integral representation is shown tc reduce to known relations, which have been used in a earlier study (Arutiunian et al., 1986).

A92-30377 Description of the nonlinear deformation of carbon-based composites (Opisanie nelineinogo deformirovaniia kompozitov na osnove ugleroda). V. S. ZARUBIN and G. N. KUVYRKIN, *Moskovskii Gosudarstvennyi Tekhnicheskii Universitet, Vestnik, Seriia Mashinostroenie* (ISSN 0236-3941), Oct.–Dec. 1990, pp. 11–17. 12 Refs.

The paper presents an approach which, given minimum initial information, makes it possible to describe the nonlinear deformation of orthotropic carbon-based composites with different resistances to tension and compression. Results are presented on the prediction of the behavior of a carbon-based composite under rigid cyclic deformation, taking the differences with respect to tension and compression into account.

A92-23591 Effective strength parameters of matrix composites (Effektivnye parametry prochnosti matrichnykh kompozitov). V. A. BURIACHENKO, IU. S. SKORBOV, and S. V. GUNIN, *Problemy Prochnosti* (ISSN 0556-171X), Dec. 1991, pp. 47–51. 21 Refs.

A method has been developed for constructing the effective strength surface of matrix composites from the properties of the components with allowance for the arbitrary anisotropy of the strength, elastic, and geometrical parameters of the components. The method is based on estimating the mean values of the first and second stress tensors for the components of a composite material. Some particular results based on this method, which are consistent with the well-known criteria, are examined.

A92-21679 Long-term fracture of a plate of an orthotropic viscoelastic composite with a central crack under constant loading (Dlitel'noe razrushenie plastiny iz ortotropnogo viazkouprugogo kompozita s tsentral'noi treshchinoi pri postoiannoi nagruzke). A. A. KAMINSKII and S. A. KEKUKH, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 27, Nov. 1991, pp. 77–84. 14 Refs.

The long-term fracture behavior of an orthotropic viscoelastic composite plate due to the subcritical propagation of a central normal tearing crack under constant loading is investigated analytically using a modified version of the delta-c model. The problem is stated in the context of the Volterra theory for integral operators. The final expressions are obtained for resolvent finite operators with kernels in the form of the Rabotnov fractional exponential function.

A92-18338 Theory of the small elastoplastic deformations of randomly reinforced composite materials (K teorii malykh uprugoplasticheskikh deformatsii khaoticheski armirovannykh kompozitsionnykh materialov). I. S. MAKAROVA and L. A. SARAEV, *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Sept.–Oct. 1991, pp. 120–124. 8 Refs.

The elastoplastic properties of a composite material containing nonoriented ellipsodial inclusions are investigated in the context of the mechanics of randomly inhomogeneous media. Expressions for calculating the elastoplastic properies of randomly reinforced composites are obtained and applied to a composite made of a sintered aluminum powder (14 percent Al2O3). The results are compared with experimental data.

A92-10844 A pseudomacrocrack in an anisotropic body (Psevdomakrotreshchina v anizotropnom tele). V. V. TVARDOVSKII, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 55, July–Aug. 1991, pp. 685–690. 10 Refs.

A pseudomacrocrack is considered which is an ordinary crack in a composite or an inhomogeneous body whose faces are bound by intact elements of the structure and interact in accordance with a linear law. In this case, normal tension is shown to be sufficient for the generation of a nonzero stress intensity factor at the crack tip. The problem is reduced to that of solving Prandtl's integrodifferential vector equation, for which an analytical solution is obtained.

A92-10843 Exact solution of a plane problem for a composite plane with a crack across the interface (Tochnoe reshenie ploskoi zadachi dlia sostavnoi ploskosti s razrezom, peresekaiushchim liniiu razdela sred). IU. A. ANTIPOV and N. G. MOISEEV, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 55, July–Aug. 1991, pp. 662–671. 8 Refs.

An exact closed-form solution is presented for the problem of stress concentration in a composite elastic plane near a rectilinear crack orthogonal to the interface. The solution is based on the factorization of a matrix coefficient of a special kind in the Riemann problem to which the elasticity problem is reduced. The solution is obtained in quadratures in a form convenient for numerical implementation. Formulas for calculating stress intensity factors and a numerical example are presented.

A92-53889 Tangential stress distribution during the bending of an orthotropic strip (O raspredelenii kasatel'nykh napriazhenii pri izgibe ortotropnoi polosy). L. A. SHAPOVALOV, *Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), No. 2, Mar.–Apr. 1992, pp. 143–150. 7 Refs.

Transverse strain and stress distribution in an orthotropic strip during bending is determined on the basis of an exact solution of the bending problem and also from an approximate solution for the cubic law of longitudinal displacement change. For both cases, the tangential stresses in the thickness direction are shown to remain constant in materials with a vanishing shear modulus. The parabolic distribution is realized only for the limiting case of infinitely large shear moduli. This result is consistent with the classical theory of beam bending based on the hypothesis of a straight normal.

A92-23574 Resonance effects in a two-layer elastic plate with a disk-shaped tearing crack at the interface (Rezonansnye effekty dvukhsloinoi uprugoi plastiny s diskovidnoi treshchinoi otryva na granitse razdela sred). D. D. ZAKHAROV and I. V. SIMONOV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Nov.–Dec. 1991, pp. 160–169. 7 Refs.

A solution to the problem of the axisymmetric oscillations of an infinite two-layer plate with an interface crack is presented which is asymptotically exact in the low-frequency region and for low ratios of the plate thickness to the crack radius. The asymptotic approach makes it possible to obtain reference results for the corresponding three-dimensional problem and to conduct a detailed parametric analysis. The amplitude-frequency characteristics of the maximum displacements, stresses, and stress intensity factors are investigated.

A92-23570 Problem of the synthesis of sandwich shells of revolution from the mechanical and radio engineering parameters (Zadacha sinteza trekhsloinykh obolochek vrashcheniia po mekhanicheskim i radiotekhnicheskim parametram). A. D. PANTELEEV, *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Nov.–Dec. 1991, pp. 112–116. 7 Refs.

The paper is concerned with the problem of the optimal design of sandwich shells with allowance for mechanical and radio engineering requirements. The shell considered here is assumed to have layers of constant thickness made of composite or dielectric materials; it is irradiated by a plane linearly polarized electromagnetic wave and performs both as a radio engineering component and a load-bearing structure. An algorithm for solving the optimum design problem is developed which includes the computation of both mechanical and electrical shell characteristics.

A93-52979 A finite element for modeling skins of composite materials (Konechnyj ehlement dlya modelirovaniya obshivok iz kompozitsionnykh materialov). I. V. KAZIMIROV, *TsAGI,* Trudy, No. 11, 1989, pp. 114–120. 5 Refs.

A finite element is proposed for implementing a model of a reinforced orthotropic shell under plane stress loading. The element is obtained using a linear formulation, with bilinear approximation of the unknown displacements within the element. The element has the shape of an arbitrary convex rectangle and consists of three layers: a skin and two stringer layers. The application of the finite element is illustrated by examples which demonstrate the sufficient accuracy of the element for practical purposes.

A93-52975 An experimental study of reinforced panels of composite materials (Ehksperimental'noe issledovanie podkreplennykh panelej iz kompozitsionnykh materialov). V. M. ANDRIENKO, A. A. IONOV, and L. V. KOPYLOVA, *TsAGI,* Trudy, No. 11, 1989, pp. 73–80. 3 Refs.

The strength and stability characteristics of reinforced panels of composite materials are examined with particular reference to the structural applications of high-strength and high-modulus composites in flight vehicles. Experimental and analytical data are presented on the stability and strength of carbon composite panels of different types. The panels considered include panels reinforced by closed-profile elements, panels with open-type reinforcement elements, and sandwich panels with a corrugated core. The weight efficiency of composite panels is estimated.

A93-52970 Determination of the limiting loads of longitudinally compressed (stretched) cylindrical shells of composite materials under nonstationary heating (Ob opredelenii predel'nykh nagruzok prodol'no szhatykh /rastyanutykh/ tsilindricheskikh obolochek iz kompozitsionnykh materialov v usloviyakh nestatsionarnogo nagreva). V. A. KIREEV, *TsAGI,* Trudy, No. 11, 1989, pp. 38–41. 5 Refs.

An analytical method for determining the limiting loads of compressed (stretched) thin-wall structures of composite materials exposed to nonstationary heating is examined, with particular reference to the estimation of the load-bearing capacity of composite structures and heat insulation components used in supersonic flight vehicles. The method presented here uses data on the material properties only, particularly the temperature dependences of the thermomechanical characteristics of the materials. Rectangular rods and shells of a glass fiber composite are considered as an example.