AMBARTSUMYAN, S.A.

Calculation of laminated shells of revolution. Dokl.AN Arm.SSR 11 no.2:59-66 '49. (MIRA 9:10)

1.Institut stroitel'nykh materialov i sooruzheniy Akademii nauk Armyanskoy SSR, Yerevan. Predstavleno A.G.Nazarovym.
(Elastic shells and plates)

AMBARTSUMYAN, S.A.

Calculating slanting cylindrical shells assembled from anisotropic layers. Izv.AN Arm.SSR.Ser.FMET nauk 4 no.5:373-391 '51.(MLRA 9:8)

1. Institut stroymaterialov i sooruzheniy Akademii nauk Armyanskoy SSR.

(Elastic plates and shells) (Anisotropy)

AMBARTSUMYAN, S.A.

Long anisotropic rotary shells. Izv.AN Arm.SSR.Ser.FMET nauk 4 no.6: 423-431 '51. (MLRA 9:8)

1. Institut stroitel'nykh materialov i sooruzheniy Akademii nauk Armyanskoy SSR.
(Anisotropy) (Elastic plates and shells)

AMBARTSUMYAN, S. A.

AMBARTSUMYAN, S. A. -- "Anisotropic Coatings." Sub 26 Jun 52, Inst of Mechanics, Acad Sci USSR. (Dissertation for the Degree of Doctor in Technical Sciences)

SO: Vechernaya Moskva, January December 1952

AMBARTSUMYAN, S.A., doktor tekhnicheskikh nauk.

S.A. Ambartsumian's dissertation "Anisotropic laminated shells." Izv. AN SSSR, Otd.tekh.nauk no.3:489-490 Mr '53. (MLRA 6:5)
(Elastic plates and shells)

AMBARTSUMYAN, S.A.

Computation of laminar anisotropic shells. Izv.AN Arm.SSR.Ser. FMET nauk 6 no.3:15-35 My-Je '53. (MLRA 9:8)

1. Institut stroitel'nykh materialov i sooruzheniy AN Armyanskoy SSR.

(Elastic plates and shells)

AMBARTSUMYAN, S.A.

USSR.

2

Ambarcumyan, S. A. On the computation of long shells of double curvature. Akad. Nauk Armyan. SSR. Izvestiya. Fiz.-Mat. Estest. Nauk 6, no. 5-6, 65-68 (1953). (Russian. Armenian summary)

The author considers a very sloping shell (a sloping shell is an open shell of small curvatures) which is made up of orthotropic layers. Solutions for such a shell are obtained from a system of two differential equations given by the author in his previous (unavailable) publications. In case of a long shell (the exact definition of a long shell must be also in the author's previous publications) the system of differential equations simplifies considerably and reduces to the one given by V. Z. Vlasov [General theory of shells, Gostehizdat, Moscow-Leningrad, 1949; MR 11, 627]. The author makes one more simplifying assumption that the Poisson ratios are zero and solves the system for a long cylindrical sloping shell curved in the longitudinal direction. For a homogeneous isotropic shell the solution reduces to the one given by V. V. Novožilov [Theory of thin shells, Gostehizdat, Moscow-Leningrad, 1951] and the author concludes that Novožilov's theory and Vlasov's theory are coincident.

T. Leser (Aberdeen, Md.).

II = F/W

AMBARTSUMYAN, S.A.

USSR/Engineering - Mechanics FD-1110

Card 1/1 Pub. 41-4/13

Author : Ambartsumyan, S. A., Yerevan

Title : On the limits of applicability of certain hypotheses of the theory of thin cylindrical shells

Periodical : Izv. AN SSSR. Otd. tekh. nauk 5, 57-72, May 1954

Abstract : Establishes the limits of applicability of certain hypotheses of the theory of thin cylindrical shells of arbitrary slope. Sixteen references. Graphs, tables.

Institution : Institute of Construction Materials and Structures of the Academy of Sciences of the Armenian SSR.

Submitted : May 21, 1954

AMBARTSUMYAN, S.A.

AMBARTSUMYAN, S.A.

Problem of computing the stability of thin-walled rods. Dokl. AN Arm. SSR 17 no.1:9-14 '54. (MLRA 7:6)

1. Institut stroitel'nykh materialov i sooruzheniy Akademii nauk Armyanskoy SSR. Predstavleno A.G.Nazarovym.
(Stability) (Elastic rods and wires)

USSR/Physics - Shell theory

FD-637

Card 1/1 : Pub. 85 - 4/12

Author : Ambartsumyan, S. A. (Yerevan)

Title : Problem of constructing approximate theories of calculating a sloping cylindrical shell

Periodical : Prikl. mat. i mekh., 18, 303-312, May/Jun 1954

Abstract : Notes that in the theory of cylindrical shells approximate methods of calculating are based on simplifying assumptions whose selection depends mainly upon the ratio and dimensions of the mean shell surface (according to V. Z. Vlasov and V. V. novozhilov, 1951). Considers here the various hypotheses.

Institution : Institute of Structures, Academy of Sciences of the Armenian SSR

Submitted : January 27, 1954

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000101220007-8"

Ambartsumyan, S.A.

203/12/3 624.074.4 :531.259.2

On the Calculation of Anisotropic Cylindrical Rotary Shells Strengthened with Transversal Ribs

S.A. Ambartsumyan

Izv.Akad.Nauk,Otd.tekh.Nauk (12)65-79 1955 U.S.S.R.

A symmetrically stressed thin cylindrical rotary shell consisting of homogeneous orthotropic layers symmetrical towards the central surface of the shell, is considered. It is assumed that the material of each layer of the shell follows Hook's expanded law. The hypothesis of non-deforming normals is assumed to be holding good. Relevant formulae are obtained for very very long or infinitely long shells. Several practical cases are considered, in which the manner of loading and the number and distribution of ribs vary. (Bibl.10)

1/2

AMBARTSUMYAN, S.A.

Calculations on a symmetrically loaded circular cylindrical shell reinforced by longitudinal ribbing. Dokl. AN Arm. SSR 21 no.4: 157-162 '55
(MLRA 9:3)

1. Institut stroitel'nykh materialov i sooruzheniy Akademii nauk Armyanskoy SSR. Predstavleno A.G. Nazarovym.
(Elastic plates and shells)

AUTHOR: Ambartsumyan, S.A. (Yerevan). 24-7-8/28

TITLE: On the calculation of two-layer orthotropic shells. (K raschetu dvukhsloynykh ortotropnykh obolochek).

PERIODICAL: "Izvestiya Akademii Nauk, Otdeleniye Tekhnicheskikh Nauk" (Bulletin of the Ac.Sc., Technical Sciences Section), 1957, No.7, pp.57-64 (U.S.S.R.)

ABSTRACT: A thin two-layer shell is considered which consists of two orthotropic layers. It is assumed that the planes of elastic symmetry of the materials of each layer are mutually perpendicular and that one of the planes of the elastic symmetry is, in each point of the layer, parallel to the external parallel surfaces of the shell, whilst the other two are perpendicular to the coordinate lines α = constant, β = constant. It is assumed that α and β are curvilinear, orthogonal coordinates which coincide with the lines of the main curvature of the coordinate surface, γ is a distance along the normal from the point of the coordinate surface to the point of the shell. The surface of adhesion of the layers which is parallel to the external surfaces of the shell is taken as the coordinate surface and it is also assumed that the coefficients of the first quadratic form $A = A(\alpha,\beta)$ and $B = B(\alpha,\beta)$ and also the main curvatures of

On the calculation of two-layer orthotropic shells.(Cont.)

24-7-8/28

range of applicability of the here presented theory is considerably wider than that of the theory constructed on the basis of the hypothesis of non-deformable normals; since the here made assumptions on the deformations correspond more closely to reality.

There are 2 figures and 12 references, all of which are Slavic.

3/3

SUBMITTED: June 25, 1956.

ASSOCIATION: Institute of Mathematics and Mechanics, Ac.Sc. Armenia. (Institut Matematiki i Mekhaniki Akademii Nauk Armyanskoy SSR).

AVAILABLE:

AMBARTSUMYAN, S.A.

Two methods for calculating two-layer orthotropic shells. Izv.AN Arm.SSR.Ser.fiz.-mat.nauk 10 no.2:17-38 '57. (MLRA 10:8)

1.Institut matematiki i mekhaniki Akademii nauk Armyanskoy SSR. (Elastic plates and shells)

AUTHOR: Ambartsumyan, S. A. (Yerevan) SOV/24-58-5-12/31

TITLE: On the Theory of Bending of Anisotropic Plates (K teorii izgiba anizotropnykh plastinok)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1958, Nr 5, pp 69-77 (USSR)

ABSTRACT: The first attempts to evolve a theory of bending of isotropic plates taking into consideration displacements in the transverse direction were made by Reissner (Refs 3 and 4) who dispensed with the hypothesis of non-deforming normals and assumed that the basic calculation stresses σ_α and σ_β and $\tau_{\alpha\beta}$ along the thickness of the plate change in accordance with a linear law. The author of this paper considers that in evolving a theory of bending of plates, particularly of anisotropic plates, it is inadvisable to assume a law of the change of the basic calculation stresses or of the respective displacements. Therefore, the hypothesis of non-deforming normals and the assumption of the linear law of distribution of the calculated stresses along the thickness of the plate are substituted

Card 1/5

SOV/24-58-5-12/31

On the Theory of Bending of Anisotropic Plates

by the hypothesis that secondary non-calculated tangential stresses $\tau_{\alpha\beta}$ and $\tau_{\beta\gamma}$ change along the plate thickness in accordance with the law $f(\gamma)$, particularly in accordance with the law of a quadratic parabola. The possible inaccuracies which may be due to the selection of the function $f(\gamma)$ do not affect greatly the final results. This hypothesis was confirmed in solved problems of the transverse bending of beams and plates. The problem is investigated of a plate of a constant thickness h, the material of which possesses in each point one plane of elastic symmetry which is parallel to the centre plane of the plate. It is assumed that for such a plate the generalised Hook law is valid. The plate is in such a position relative to the triorthogonal system of rectilinear coordinates that the coordinate plane $\alpha\beta$ coincides with the centre of the plane of the plate and the gamma coordinate is directed towards the load-free external plane. The following assumptions are made:

Card 2/5

a) the normal stresses σ_{γ} on the planes which are

SOV/24-58-5-12/31

On the Theory of Bending of Anisotropic Plates

parallel to the centre plane can be disregarded as compared to other stresses;
b) the distance along the normal (γ) between two points of the plate remains unaffected by the deformation;
c) the tangential stresses $\tau_{\alpha\gamma}$ and $\tau_{\beta\gamma}$ along the thickness of the plate vary in accordance with a given law, $f(\gamma)$; since it is known from the work of other authors (Refs 1, 2, 5-8) that the tangential stresses $\tau_{\alpha\gamma}$ and $\tau_{\beta\gamma}$ change along the thickness of a beam or a plate almost according to the parabolic law with zero values at the initial and at the end points ($-h/2$ and $+h/2$). This function can best be expressed by the relation:

$$f(\gamma) = \frac{1}{2}\left(\gamma^2 - \frac{1}{4}h^2\right) \qquad (5.1)$$

The results obtained by means of this theory are compared for the case of bending of a square isotropic plate which is freely supported along its contour with results obtained by other methods, namely, by means of

Card 3/5

SOV/24-58-5-12/31

On the Theory of Bending of Anisotropic Plates

the accurate theory of Vlasov (Ref 8) and by the classical theory of Timoshenko (Ref 9). The comparison shows that even for a very thick plate (h/a = 1/3), the error in the values of bending does not exceed 5.8% compared with the results obtained by the accurate theory, whilst the errors of the results calculated by means of the classical theory of Timoshenko amount to up to 35%. In his manuscript devoted to the Reissner theory of bending of plates, A. L. Gol'denveyzer (Ref 10) shows that in evolving the theory of plates without taking into consideration the phenomenon of transverse shear it is not advisable to apply a linear law of variation of σ_α and σ_β and $\tau_{\alpha\beta}$ along the thickness of the plate, particularly when it is necessary to solve the problem of satisfying with sufficient accuracy the boundary conditions. The bending of the plates can be effected by applying to the faces of the plate forces which change in a way greatly different from that assumed by Reissner and in this case serious errors may arise.

Card 4/5

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SOV/24-58-5-12/31

On the Theory of Bending of Anisotropic Plates

Acknowledgments are made to A. L. Gol'denveyzer for his comments on this work.

There are 1 table and 10 references, 8 of which are Soviet, 2 English.

ASSOCIATION: Institut matematiki i mekhaniki AN Arm SSR (Institute of Mathematics and Mechanics, Ac.Sc., Armenian SSR)

SUBMITTED: January 16, 1958

Card 5/5

SOV/24-58-10-24/34

AUTHORS: Ambartsumyan, S. A., Zadoyan, M. A. (Yerevan)

TITLE: On the Problem of Elasto-Plastic Bending of Beams (K zadache uprugo-plasticheskogo izgiba balok)

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, 1958, Nr 10, pp 130-132 (USSR)

ABSTRACT: The theory of bending of beams is based on the hypothethis of plane cross-sections and does not take into account the effect of tengential stresses on the form of the bent axis of the beam. This restriction is removed in the present paper and an attempt is made to determine the role of tangential stresses in elasto-plastic bending of beams. Explicit expressions are derived and these can be used to estimate the effect. The present work is a development of the treatment given by Prager and Khodzh (Ref.1) and the first of the present authors (Refs.2 and 3). There is 1 figure and there are 3 Soviet references.

ASSOCIATION: Institut matematiki i mekhaniki AN Armyanskoy SSR (Institute of Mathematics and Mechanics, AS Armyanskaya SSR)

SUBMITTED: June 23, 1958

Card 1/1

AMBARTSUMYAN, S.A.; PESHTMALDZHYAN, D.V.

Nonlinear theory of slanting orthotropic shells. Izv. AN Arm. SSR. Ser. fiz.-mat. nauk 11 no.1:15-26 '58. (MIRA 11:6)

1. Institut matematiki i mekhaniki AN Armyanskoy SSR.
(Elastic plates and shells)

AUTHOR: Ambartsumyan, S.A. (Yerevan) 40-22-2-10/21

TITLE: On the General Theory of Anisotropic Shells (K obshchey teorii anizotropnykh obolochek)

PERIODICAL: Prikladnaya matematika i mekhanika, 1958, Vol 22, Nr 2, pp 226-237 (USSR)

ABSTRACT: The author considers thin anisotropic shells of constant thickness. It is assumed that the material of the shells satisfies the law of Hooke, and that in each point of the shell an elastic plane of symmetry exists which runs in parallel with the central plane of the shell.
The author introduces curvilinear orthogonal coordinates which coincide with the main directions of curvature of the shell. It is presupposed that an element lying normally to the shell surface does not change its length during the deformation. Furthermore the normal stresses are assumed to be small compared with the tangential stresses. Furthermore it is supposed that the tangential stresses are distributed over the thickness of the disks according to a quadratic law.
Under these assumptions now a system of differential equations for the calculation of anisotropic shells can be set up which covers several pages in the representation of the author. Be-

Card 1/2

sides of this system of differential equations the boundary conditions must be also considered; the author investigates four different kinds of them :

1. The freely resting boundary,
2. the freely pivoted boundary,
3. the rotarily fastened boundary and
4. the fixed boundary.

For the case of a circular cylindric shell the systems of formulas are simplified, but they are still very complicated. They are essentially simplified for the case that the shells are isotropic in the tangential direction. For this case the problem of a horizontally supported tube is considered which is freely supported at the ends and which is completely filled with a liquid. The numerical calculation of this case shows that the error of the classical theory in this case can rise up to 15% compared with the improved theory by the author. There are 1 table, and 13 Soviet references.

SUBMITTED: January 13, 1958

1. Cylindrical shells--Theory

Card 2/2

16(1)

AUTHORS: Ambartsumyan, S.A. and Peshtmaldzhyan, D.V. SOV/22-12-1-3/8

TITLE: On the Theory of Orthotropic Shells and Plates (K teorii ortotropnykh obolochek i plastinok)

PERIODICAL: Izvestiya Akademii nauk Armyanskoy SSR, Seriya fiziko-matematicheskikh nauk, 1959, Vol 12, Nr 1, pp 43-60 (USSR)

ABSTRACT: The author considers a thin orthotropic shell. In the curvilinear coordinate system α, β, γ the medium surface is assumed to have the equation $\gamma = 0$; let the directions of α, β be identical with the directions of the principal curvatures. Let the planes of elastic symmetry of the material be parallel with the coordinate surfaces in every point. The displacement along the normal w is assumed to be independent of γ. The normal stress $\sigma_{\gamma\gamma}$ is assumed to influence only unessentially the deformations $e_{\alpha\alpha}$, $e_{\beta\beta}$, $e_{\alpha\beta}$. The tangential stresses $\tau_{\alpha\beta}$, $\tau_{\beta\gamma}$ change according to the law $f(\gamma)$ so that $e_{\alpha\gamma} = a_{55} f(\gamma) \varphi_1(\alpha,\beta)$, $e_{\beta\gamma} = a_{44} f(\gamma) \varphi_2(\alpha,\beta)$

Card 1/2

On the Theory of Orthotropic Shells and Plates SOV/22-12-1-3/8

where a_{55} , a_{44} are elastic constants, $f(\gamma)$ is the given function and φ_1 , φ_2 arbitrary sought functions. Under these assumptions the author calculates the moments and stresses, substitutes them into conditions of equilibrium and obtains a system of five differential equations (not presented because of its complicatedness) for the calculation of the five unknowns u,v,w, φ_1, φ_2 .

An explicit calculation is carried out in the following special cases 1. Shells rectangular in plan form of positive Gauss curvature ; 2. Spherical shells ; 3. Round plates with freely resting boundary and fixed boundary.
There are 12 references, 10 of which are Soviet, 1 English, and 1 American.

ASSOCIATION: Institut matematiki i mekhaniki AN Armyanskoy SSR (Institute of Mathematics and Mechanics, AS Armenian SSR)

SUBMITTED: October 15, 1958

AMBARTSUMYAN, S.A.; KHACHATRYAN, A.A.

Stability and vibrations of anisotropic plates. Dokl AN Arm. SSR 29 no.4:159-166 '59. (MIRA 13:4)

1. Institut matematiki i mekhaniki AN ArmSSR. 2. Chlen-korrespondent AN ArmSSR (for Khachatryan).
(Elastic plates and shells)

AMBARTSUMYAN, S. A. (Acad. Sci. USSR)

"On a general theory of anisotropic shells and plates."

Report presented at the 10the International Congress of Applied Mechanics, (ICSU) Stresa, Italy, 31 August - 7 Sep 1960.

The system of governing equations is of tenth order for shells and of sixth order for plates. Only one planesof elastic symmetry parallel to the middle surface is assumed to exist. It turns out that a certain relative reduced thickness, which depends both on the square of relatives thickness of the shell and on the relatives values of physical and mechanical properties, is of great importance. The author shows that the results of problems of equilibrium, static stability, vibrations, and dynamic stability of plates and shells obtained on the basis of the classical theory may be very different as compared to those obtained on the basisof the anisotropic theory. In the case of static stability, for example, as the relatives reduced thickness increases, the value of the critical force tends to decrease in comparison with the critical force obtained according to the classical theory.

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AUTHORS: Ambartsumyan, S.A. and Khachatryan, A.A. (Yerevan)

TITLE: The Stability and Vibrations of Anisotropic Plates

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Mekhanika i mashinostroyeniye, 1960, Nr 1, pp 113-122 (USSR)

ABSTRACT: The paper is a continuation of previous work (Ref 1). It is assumed (1) that the plate is orthotropic, rectangular and of constant thickness h, with one plane of elastic symmetry parallel to the middle surface and the other two planes parallel to the sides; (2) the rectangular coordinate system (α, β, γ) is such that the $\alpha\beta$ plane is parallel to the middle surface with the α and β axes parallel to the sides; (3) the normal stress σ_γ on planes parallel to the middle surface can be neglected in comparison with the remaining stresses; (4) the distance along the normal (γ) between two points on the plate after deformation remains unchanged; (5) the tangential shear stresses $\tau_{\alpha\gamma}$ and $\tau_{\beta\gamma}$ are given by

Card 1/7

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000101220007-8"

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The Stability and Vibrations of Anisotropic Plates

Eq (1.1), where $\varphi(\alpha,\beta)$ and $\psi(\alpha,\beta)$ are arbitrary initial functions. The bending of the plate is governed by the three differential equations (1.2) containing the normal deflection of the plate w, the functions φ and ψ and the elastic constants of the plate B_{ij} and a_{ij}. In stability problems Z is given by Eq (2.1) and the equations become (2.2). For a simply supported plate subjected to bi-axial compression (Fig 1), the solution of the equations can be written in the form (2.4) which on substitution in (2.2) gives (2.5). The critical stress P^*_{mn} is then found as (2.6) with P°_{mn}, the critical stress, assuming the validity of the Kirchhof hypothesis, given by Eq (2.7), and d given by Eqs (2.8). If the plate is compressed in one direction only, Eq (2.7) is replaced by Eq (2.9). If the plate is made of a transversely isotropic material with the isotropic planes parallel to the middle surface of the plate, the equation for critical stress becomes (2.10) with D, c and k given by (2.11) and E, μ elasticity modulus and Poisson's

Card 2/7

69297

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E081/E535

The Stability and Vibrations of Anisotropic Plates

ratio in the isotropic planes, G' is the shear modulus characterizing the change in angle between directions in the isotropic planes and directions perpendicular to them. The minimum value of the critical stress occurs when there is one half wave in the direction perpendicular to the stress; in this case (n = 1) Eq (2.11) becomes (2.12). Table 1 gives values of k and coordinates of some characteristic points of the curves $\Phi = \Phi(c) = p^* b^2/\pi^2 D_{11}$ for $\mu = 0.25$. In the upper part of the table h/b = 0.1 and in the lower part h/b = 0.2. Values of Φ are plotted against c = a/b in Fig 2; the curve for k = 0 corresponds to the classical solution. Values of Φ(c) for orthotropic plate (obtained on the electronic calculating machine M-3 of the Calculating Centre, Ac.Sc., ArmSSR) and for various values of k_1 and c are given in Table 2. It is assumed that m = 1 and

$$\frac{E_1}{E_2} = \frac{\mu_1}{\mu_2} = \frac{E_1}{B_{66}} = 5, \quad k_1 = a_{55}E_1 = a_{44}E_2, \quad \frac{h}{b} = \frac{1}{10}, \quad \mu_1 = 0.3$$

Card 3/7

69297

S/179/60/000/01/014/034
E081/E535

The Stability and Vibrations of Anisotropic Plates

where E_1, μ_1 and E_2, μ_2 are the elasticity moduli and Poisson's ratios in the directions corresponding to α and β. For free vibrations, Z (eq 1.2) is replaced by

$$Z = -\frac{\gamma_o h}{g}\frac{\partial^2 w}{\partial t^2}$$

which leads to Eq (3.1), with γ_o the density of the material and g the gravitational acceleration. Writing the solution of (3.1) in the form (3.2) leads to the equation (3.3) for the frequency ω_{mn}, where ω^o_{mn} (Eq 3.4) is the frequency according to the classical solution. For a transversely isotropic plate, the frequency reduces to (3.5). Table 3 gives values of the ratio $\omega_{mn}/\omega^o_{mn}$ for modes of vibration in which m,n = 1.2. The departure of the true frequency from the classical frequency increases with increasing k and with increasing mode number. The equations of dynamic stability of an orthotropic plate are obtained by substituting the

Card 4/7

69297

S/179/60/000/01/014/034
E081/E535

The Stability and Vibrations of Anisotropic Plates

expression (4.1) for Z in (1.2). If the plate is compressed in one principal direction only, the conditions (4.2) hold; assuming that the external force varies periodically with time ((Eq 4.3) where P_o is the amplitude and θ is the frequency), Eqs (1.2) take the form (4.4). Taking the solution in the form (4.5), where w(t), φ(t) and ψ(t) are values of the functions w, φ and ψ at the centre of the plate, Eqs (4.4) become (4.6). Eliminating φ(t) and ψ(t) from (4.6) with respect to w, the differential equation (4.7) is obtained, where ω_{mn}, P^*_{mn} are the frequency of vibration of the unloaded plate (3.3), and the critical stress for uniaxial stress in the α direction. Eq (4.7) is the known Mattieu equation; for certain relations between its coefficients the solution increases without limit, corresponding to regions of dynamic instability of the plate. Rewriting (4.7) in the form (4.8), it is known (Ref 7) that the limits of the unstable regions are given by (4.9) for the first (principal) instability

Card 5/7

69297

S/179/60/000/01/014/034
E081/E535

The Stability and Vibrations of Anisotropic Plates

region, by (4.10) for the second region and by (4.11) for the third region, where θ^* is the critical frequency of the external forces. It will now and subsequently be assumed that there is one half wave only in the α and β directions (i.e. m = n = 1) and for simplicity the subscripts 11 are omitted. Under these conditions, the dynamic instability regions of a square plate (a = b) of transversely isotropic material are given by (4.13, 1st region), (4.14, 2nd region) and (4.15, 3rd region) in which the results are presented in a form for comparison with the classical results. From (4.8) $\lambda \leqslant 1/2$ and accordingly, the limiting λ^o is given by (4.16). The values of $\theta^*/2\omega^o$ as a function of λ^o calculated from (4.13) to (4.15) for various values of k are presented in Table 4; Fig 3 shows the instability regions for k = 0 and k = 0.2. Fig 3 and Table 4 show that the instability regions differ from the classical values (k = 0) by greater amounts as k increases. Similar calculations for a square

Card 6/7

69297

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E081/E535

The Stability and Vibrations of Anisotropic Plates

orthotropic plate were made electronically; the results are given in Table 5, where

$$k_1 = \frac{E_1}{E_2} = \frac{\mu_1}{\mu_2} = \frac{E_1}{G_{12}}, \qquad k_2 = a_{55}E_1 = a_{44}E_2$$

where E_1, μ_1 and E_2, μ_2 are the elasticity moduli and Poisson's ratios in the directions corresponding with α and β; $G_{12} = B_{66}$ with a_{55}, a_{44} and B_{66} known elasticity constants (top of p 114). The calculations were carried out for $\mu_1 = 0.3$, $h/a = 0.1$.
There are 5 tables, 3 figures and 7 Soviet references.

ASSOCIATION: Institut matematiki i mekhaniki AN ArmSSR
(Institute of Mathematics and Mechanics, Ac.Sc., ArmSSR)

SUBMITTED: June 19, 1959

Card 7/7

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S/179/60/000/006/012/036
E081/E135

AUTHOR: Ambartsumyan, S.A., (Yerevan)

TITLE: The Bending of Non-Linearly Elastic Three-Ply Plates

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Mekhanika i mashinostroyeniye, 1960, No. 6, pp. 86-90

TEXT: A three-ply plate is considered which consists of non-linearly elastic layers symmetrically located with respect to the middle layer of the plate (Fig.1). The plate is related to a cartesian coordinate system α, β, γ such that the middle plane of the plate coincides with the plane $\alpha\ \beta$. The following hypotheses and assumptions are made: (a) the hypothesis of undeformed normals for each part of the plate as a whole; (b) incompressibility of the material in each layer of the plate; (c) coincidence of the directions of the stress and strain tensors in each layer of the plate; (d) the non-linear relation

$$T_i = a_i E_i - b_i E_i^{m_i} \qquad (1.1)$$

Card 1/10

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The Bending of Non-Linearly Elastic Three-Ply Plates

exists between the stress (T_i) and strain (E_i), where i = number of the layers, a_i, b_i and m_i are constants of the material determined experimentally in simple compression-tension. The strains in the i-th layer are given approximately by:

$$e_\alpha^i = -\gamma\varkappa_1, \quad e_\beta^i = -\gamma\varkappa_2, \quad e_{\alpha\beta}^i = -\gamma\tau \tag{1.2}$$

$$e_\gamma^i = -e_\alpha^i - e_\beta^i, \quad e_{\alpha\gamma}^i = 0, \quad e_{\beta\gamma}^i = 0 \tag{1.3}$$

$$\varkappa_1 = \frac{\partial^2 w}{\partial\alpha^2}, \quad \varkappa_2 = \frac{\partial^2 w}{\partial\beta^2}, \quad \tau = 2\frac{\partial^2 w}{\partial\alpha\,\partial\beta} \tag{1.4}$$

where w is the normal displacement. The stresses can be approximately calculated by means of the equations:

Card 2/10

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E081/E135

The Bending of Non-Linearly Elastic Three-Ply Plates

$$\sigma_\alpha^{i} = -\frac{4}{3}\gamma a_i\left(\varkappa_1 + \frac{1}{2}\varkappa_2\right) + \\ + \operatorname{sign}\gamma\left(\frac{2}{\sqrt{3}}\right)^{m_i+1}|\gamma|^{m_i} b_i(\sqrt{P_\varkappa})^{m_i-1}\left(\varkappa_1 + \frac{1}{2}\varkappa_2\right) \tag{1.8}$$

$$\sigma_\beta^{i} = -\frac{4}{3}\gamma a_i\left(\varkappa_2 + \frac{1}{2}\varkappa_1\right) + \\ + \operatorname{sign}\gamma\left(\frac{2}{\sqrt{3}}\right)^{m_i+1}|\gamma|^{m_i} b_i(\sqrt{P_\varkappa})^{m_i-1}\left(\varkappa_2 + \frac{1}{2}\varkappa_1\right) \tag{1.9}$$

$$\tau_{\alpha\beta}^{i} = -\frac{1}{3}\gamma a_i\tau + \operatorname{sign}\gamma\,\frac{1}{4}\left(\frac{2}{\sqrt{3}}\right)^{m_i+1}|\gamma|^{m_i} b_i(\sqrt{P_\varkappa})^{m_i-1}\tau \tag{1.10}$$

These stresses determine the bending moments M_α, M_β, and the twisting moment H, which are expressed in terms of the linear (D_e) and non-linear (D_p) cylindrical rigidities by:

Card 3/10

88520
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E081/E135

The Bending of Non-Linearly Elastic Three-Ply Plates

$$M_\alpha = -(D_e - D_p)\left(\varkappa_1 + \tfrac{1}{2}\varkappa_2\right), \qquad H = -\tfrac{1}{4}(D_e - D_p)\tau \quad (1.11)$$
$$M_\beta = -(D_e - D_p)\left(\varkappa_2 + \tfrac{1}{2}\varkappa_1\right),$$

Using the equilibrium equation

$$\frac{\partial^2 M_\alpha}{\partial \alpha^2} + 2\frac{\partial^2 H}{\partial \alpha\, \partial \beta} \quad \frac{\partial^2 M_\beta}{\partial \beta^2} + Z = 0 \quad (1.14)$$

the non-linear differential equation

$$D_e\nabla\nabla w - D_p\nabla\nabla w - 2\frac{\partial D_p}{\partial\alpha}\left(\frac{\partial^3 w}{\partial\alpha^3} + \frac{\partial^3 w}{\partial\alpha\,\partial\beta^2}\right) - 2\frac{\partial D_p}{\partial\beta}\left(\frac{\partial^3 w}{\partial\beta^3} + \frac{\partial^3 w}{\partial\beta\,\partial\alpha^2}\right) -$$
$$- \frac{\partial^2 D_p}{\partial\alpha^2}\left(\frac{\partial^2 w}{\partial\alpha^2} + \frac{1}{2}\frac{\partial^2 w}{\partial\beta^2}\right) - \frac{\partial^2 D_p}{\partial\beta^2}\left(\frac{\partial^2 w}{\partial\beta^2} + \frac{1}{2}\frac{\partial^2 w}{\partial\alpha^2}\right) - \frac{\partial^2 D_p}{\partial\alpha\,\partial\beta}\frac{\partial^2 w}{\partial\alpha\,\partial\beta} = Z \quad (1.15).$$

Card 4/10

88520

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E081/E135

is obtained ($\nabla = \partial^2/\partial\alpha^2 + \partial^2/\partial\beta^2$). For a circularly symmetrical problem, the equation when transformed to cylindrical coordinates becomes:

$$D_e\left(\frac{d^4w}{dr^4}+\frac{2}{r}\frac{d^3w}{dr^3}-\frac{1}{r^2}\frac{d^2w}{dr^2}+\frac{1}{r^3}\frac{dw}{dr}\right)-D_p\left(\frac{d^4w}{dr^4}+\frac{2}{r}\frac{d^3w}{dr^3}-\frac{1}{r^2}\frac{d^2w}{dr^2}+\frac{1}{r^3}\frac{dw}{dr}\right)-$$
$$-\frac{dD_p}{dr}\left(2\frac{d^3w}{dr^3}+\frac{5}{2r}\frac{d^2w}{dr^2}-\frac{1}{r^2}\frac{dw}{dr}\right)-\frac{d^2D_p}{dr^2}\left(\frac{d^2w}{dr^2}+\frac{1}{2r}\frac{dw}{dr}\right)=Z \quad (1.19)$$

As an illustration, the problem is considered of the cylindrical bending of an infinite 3-ply strip formed from non-linearly elastic materials, and subjected to the action of a uniformly distributed load q (Fig.2). The equation to be solved is then:

$$D_e\frac{d^4w}{d\alpha^4}-\left[\frac{d^4w}{d\alpha^4}+2\frac{d^3w}{d\alpha^3}\frac{d}{d\alpha}+\frac{d^2w}{d\alpha^2}\frac{d^2}{d\alpha^2}\right]\left[D_1\left(\frac{d^2w}{d\alpha^2}\right)^{m_1-1}+D_2\left(\frac{d^2w}{d\alpha^2}\right)^{m_2-1}\right]=q \quad (2.1)$$

88520

S/179/60/000/006/012/036
E081/E135

The Bending of Non-Linearly Elastic Three-Ply Plates

Particularly, taking

$$h_1 = h_3 = 1.1, \quad h_2 = 1.0, \quad l = 20.0 \quad [\text{см}]$$

$$a_1 = a_3 = 10^6, \quad a_2 = 10^4, \quad b_1 = b_3 = 10^9, \quad b_2 = 10^6 \quad [\text{кг/см}^2]$$

$$m_1 = m_2 = m_3 = 2$$

For the rigidities and the rigidity coefficients we obtain:
$D_e = 3.031 \cdot 10^5$ kg.cm^2; $D_2 = 7.698 \cdot 10^5$ kg.cm^2; $D_1 = 0.357275 \cdot 10^9$ kg.cm^2.

In this case, Eq. (2.1) simplifies to

$$D_e \frac{d^4w}{d\alpha^4} - 2(D_1 + D_2)\left[\frac{d^2w}{d\alpha^2}\frac{d^4w}{d\alpha^4} + \frac{d^3w}{d\alpha^3}\frac{d^3w}{d\alpha^3}\right] = q \qquad (2.2)$$

which is solved by the method of disturbances (Refs 3-5). For a strip with built-in ends, the boundary conditions are:

$$w = 0, \quad dw/d\alpha = 0, \quad \text{where} \quad \alpha = \pm l \qquad (2.3)$$

Card 6/10

88520

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E081/E135

The Bending of Non-Linearly Elastic Three-Ply Plates

The deflection and load are taken as the power functions

$$w = w_1\xi + w_3\xi^3 + w_5\xi^5 + \dots,$$
$$q = q_1\xi + q_3\xi^3 + q_5\xi^5 + \dots \quad (2.5)$$

of the deflection ξ at the centre of the strip. The straight line in Fig.3 gives the relationship between q and ξ when one term of the series (2.5) is taken; the curve in this figure represents the relationship when the first two terms of the series (2.5) are taken. The normal stress σ_α^i at $\alpha = 0$ is calculated from

$$\sigma_\alpha^i = -\frac{4}{3} a_i \gamma \frac{d^2 w}{d\alpha^2} + \frac{8}{\sqrt{27}} b_i \gamma^3 \left|\frac{d^2 w}{d\alpha^2}\right| \frac{d^2 w}{d\alpha^2} \quad (2.15)$$

which gives $\zeta = 1.164 \cdot 10^{-2}$ for q = 0.5 kg/cm^2, and $\zeta = 2.494 \times 10^{-2}$ for q = 1.0 kg/cm^2. By means of these values the corresponding values of w are obtained which, when inserted in

Card 7/10

88520
S/179/60/000/006/012/036
E081/E135

The Bending of Non-Linearly Elastic Three-Ply Plates

(2.15), give the following equations for the stresses:

$$\sigma_\alpha^{\ i} = 1.424\cdot10^{-4}\ a_{i\gamma} - 1.756\cdot10^{-8}\ b_{i\gamma}2 \quad \text{for } q = 0.5,$$

$$\sigma_\alpha^{\ i} = 2.7373\cdot10^{-4}\ a_{i\gamma} - 6.489\cdot10^{-8}\ b_{i\gamma}2 \quad \text{for } q = 1.0.$$

The values of $\sigma_\alpha^{\ i}$ (kg/cm²) for the external layer (γ = 1.1) and the internal layer (γ = 1.0) are as follows:

	Non-linear theory		Linear theory	
	q = 0.5	q = 1.0	q = 0.5	q = 1.0
External layer	135.4	222.6	161.3	322.6
Internal layer	1.41	2.67	1.47	2.94

These results, and those of Fig.3, show that appreciable errors arise in determining the stresses and displacements if the non-linear properties are not taken into account.

Card 8/10

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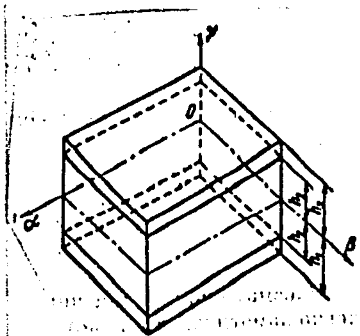
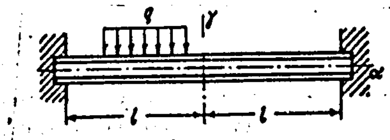
E081/E135

The Bending of Non-Linearly Elastic Three-Ply Plates

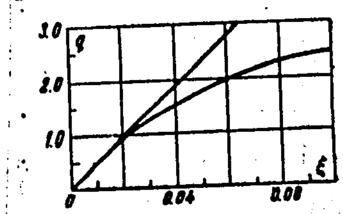
The purely illustrative character of the examples is emphasised.



Фиг. 1



Фиг. 2



Фиг. 3

Card 9/10

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The Bending of Non-Linearly Elastic Three-Ply Plates

There are 3 figures and 5 Soviet references.

ASSOCIATION: Institut matematiki i mekhaniki, AN ArmSSR
(Institute of Mathematics and Mechanics, AS Arm.SSR)

SUBMITTED: May 30, 1960

Card 10/10

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80254
S/040/60/024/02/20/032

AUTHOR: Ambartsumyan, S. A. (Yerevan)

TITLE: On the Bending Theory of Anisotropic Plates and Flat Shells

PERIODICAL: Prikladnaya matematika i mekhanika, 1960, Vol. 24, No. 2, pp. 350-360

TEXT: The author considers a thin orthotropic shell with the constant thickness h. He assumes that the material obeys to the generalized Hooke law and that in every point there are three planes of elastic symmetry whose normals coincide with the direction of the coordinate lines α, β, γ. The α, β -lines are identical with the main curvature lines of the central surface; the central surface is the α, β coordinate surface. The coordinate line γ is the normal of the central surface. Instead of the assumption that the normals are transformed again into normals by the deformation the author assumes: a.) The distance between two points of the shell (on the normal γ) remains constant under the deformation, b.) the tangential stresses $\tau_{\alpha\gamma}$ and $\tau_{\beta\gamma}$ change in dependence on the γ -coordinate according to a prescribed law. If the shell is particularly subject to a normal load Z only, then it is chlosen according to (Ref.3,4):

Card 1/2

AMBARTSUMYAN, S.A.; KHACHATRYAN, A.A.

Stability and vibrations of a shallow orthotropic cylindrical panel. Dokl.AN Arm.SSR 30 no.1:39-45 '60. (MIRA 13:7)

1. Institut matematiki i mekhaniki Akademii nauk Armyanskoy SSR i Yerevanskiy gosudarstvennyy universitet. 2. Chlen-korrespondent AN Armyanskoy SSR (for Ambartsumyan).
(Elastic plates and shells)

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S/124/62/000/009/023/026
A057/A101

AUTHOR: Ambartsumyan, S. A.

TITLE: Theory of anisotropic shells

PERIODICAL: Referativnyy zhurnal, Mekhanika, no. 9, 1962, 14 - 15, abstract 9V89 K (Moscow, Fizmatgiz, 1961, 384 pages, illustrated)

TEXT: In the book are collected and systematically presented the results of the investigation upon the problem of elastic equilibrium of anisotropic shells and partially anisotropic plane plates (special questions). First is presented in the monography the accumulated wide material upon the theory of anisotropic shells, published in numerous articles in periodicals. As basis, investigations of the author are laid down, but also works carried out by other scientists are indicated. The main part of the book is dedicated to problems of the stressed and deformed state of various shells, which are composed of series of anisotropic layers glued or soldered along the contact surface, and studied from the standpoint of the linear theory of elasticity and classical theory of shells, based on the hypothesis of straight normals and other assumptions. Si-

Card 1/5

multaneously with the presentation of general aspects of the basic problems of the theory of shells, the book contains a great number of particular questions and numerical examples with tables and diagrams. The book is divided into seven chapters. Chapter I has an introductional character; in it are reported the necessary data upon curvilinear coordinates, presented terms for the components of deformation, equations for the equilibrium of the element of the shell, and equations which express the generalized Hooke's law for the basic forms of anisotropy. Formulas are given for the transformation of elastic constants at the transition to a new system of coordinates and numerical values of elastic constants for a series of anisotropic materials. In chapter II are reported general equations of the theory of shells, composed of anisotropic layers. First is discussed a general case of a shell, when the layers have an arbitrary thickness and their number is arbitrary, and anisotropy is characterized by the presence of only one plane of elastic symmetry, parallel to the coordinate surface of the shell. Based on the hypothesis of straight normals and other assumptions, expressions are deduced for stresses, inner forces and moments, equations for equilibrium, elasticity relations and indicated basic cases of boundary conditions. Furthermore are discussed special cases: shells composed of an arbitrary number of orthotropic, isotropic, or transversally isotropic layers and of an odd number of layers, located symmetrically in relation to the middle surface. The case of a monolayer shell is discussed, and compared to the case of a multilayer shell in order to determine the relation between them. It is demonstrated that in a general case the calculation of a multilayer shell should not be identified unconditionally with some monolayer shell (§ 15). The chapter III is dedicated to the membrane theory of anisotropic shell. First is discussed the monolayer shell, for which are deduced the basic equations of the membrane theory and presented their integration for a symmetrically loaded shell of revolution of an arbitrary form. Furthermore are discussed shells of special shape: 1) cylindrical, 2) conical, 3) spherical, and 4) formed by revolution of circle arc, studying the general case, as well as special cases. The results are generalized without considerable changes for the case of a symmetrically constructed laminated shell and demonstrated on the example of a triple-layer cylindrical shell. In the presentation of the following three chapters IV - VI the author keeps the following sequence. First is discussed the multi-layer shell of a general form with layers having only one plane of elastic symmetry each, and all formulas and equations are presented for it. Then are discussed basic special cases, when the layers

Theory of anisotropic shells S/124/62/000/009/023/026
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are orthotropic, isotropic, or transversally isotropic, but oriented arbitrarily and when the layers are oriented symmetrically in relation to the middle layer; in the last case, specially in the presence of orthotropic layers, considerable simplifications of all equations and the corresponding solutions are obtained. In chapter lV is discussed the theory of axisymmetric deformation of shells of revolution. General equations, solving equations, and formulas for all mechanical quantities are derived. The method of asymptotic integration of the solving equation is described. The problem of the boundary effect and long shells of revolution is discussed and several examples given for the calculation of cylindrical, conical, and spherical shells. In § 12 are investigated cylindrical shells with transversal (circular) reinforcing ribs. Chapter V is dedicated to the problem of equilibrium of a cylindrical shell with circular cross section, loaded arbitrarily. After deriving the general equations, the technical theory is presented by using additional assumptions. Two general methods for the formation of solutions based on the technical theory are discussed. A method for the solution of a shell with open profile by means of double-series (applied also to the particular case of a shell with closed profile) is given, as well as a method based on the use of single-series. The methods are illustrated on several ex-

Card 4/5

Theory of Anisotropic shells

S/124/62/000/009/023/026
A057/A101

amples. In chapter VI is presented the theory of slanting shells. General equations, solution equations and formulas for all mechanical quantities are derived. By means of double series the solution is found for a very slanting shell, rectangular in the plan. Several numerical examples are discussed. In chapter VII are discussed more rigorous theories of anisotropic plates and shells, not using the hypothesis of straight normals. Three different theories are presented, which are applied to mono-layer plates and shells, as well as to multi-layer slanting shell and triple-layer cylindrical shell. A comparison of the results, obtained on the basis of different theories is made on particular examples.

S. G. Lekhnitskiy

[Abstracter's note: Complete translation]

Card 5/5

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28970
S/179/61/000/003/012/016
E081/E435

AUTHORS: Ambartsumyan, S.A. and Gnuni, V.Ts. (Yerevan)

TITLE: Forced vibrations and dynamic stability of 3-ply orthotropic plates

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Mekhanika i mashinostroyeniye, 1961, No.3, pp.117-123

TEXT: The paper is a continuation of previous work (Ref.6: Ambartsumyan S.A. PMM, 1960, Vol.XXIV, No.2; Ref.11: Gnuni V.Ts. Izv. AN Arm.SSR, ser. fiz.-mat. nauk, 1960, Vol.XIII, No.1; Ref.14: Ambartsumyan, S.A., Khachatryan A.A. Izv. AN SSSR, OTN, Mekhanika i mashinostroyeniye, 1960, No.1; Ref.16: Ambartsumyan S.A. Theory of anisotropic shells. Fizmatgiz 1961). The material in each layer of the plate obeys the generalized Hooke's law and has three orthogonal planes of elastic symmetry at each point, with principal directions α, β, γ, the γ direction coinciding with the thickness of the plate. The following assumptions are made: 1. The hypothesis of undeformed normals applies to the external (bearing) layers. 2. For the internal layer: a) the shear stresses $\tau_{\alpha\gamma}$ and $\tau_{\beta\gamma}$ have the form

Card 1/3

28970
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E081/E435

$$\tau_{\alpha\gamma} = f(\gamma)\varphi(\alpha,\beta), \qquad \tau_{\beta\gamma} = f(\gamma)\psi(\alpha,\beta) \quad (1.1)$$

where $\varphi(\alpha,\beta)$ and $\psi(\alpha,\beta)$ are functions to be determined and $f(\gamma)$ is a function characterizing the law of change of shear stresses through the thickness, subject to the condition $f(\pm h/2) = 0$; b) the normal stress σ_γ on planes parallel to the middle surface can be neglected in comparison with the other stresses; c) the normal displacement is invariant with thickness. 3. The normal displacements are comparable with the thickness, and only those non-linear terms arising from the normal displacements are retained in the expressions for the deformation of the middle surface. On the basis of these assumptions, the differential equations governing the deflection and stress functions of the plate are stated. The deflection and stress functions for a plate simply supported at the edges and subjected to compressive stresses P_1, P_2 in its plane are assumed to be double infinite trigonometric series and expressions are obtained for the frequency of vibration and the critical values of the stresses P_1 and P_2. The dynamic stability of the system and the shape of the resonance curve are also discussed. Special cases of the equations are discussed and the equations are illustrated by numerical examples. There are 6 figures, 1 table and 18 references: 17 Soviet and 1 non-Soviet. The reference to an English language publication reads as follows: Reissner E. Small Bending and Stretching of Sandwich-Type Shells. NACA Report, 1950, 975.

ASSOCIATION: Institut matematiki i mekhaniki AN ArmSSR (Institute of Mathematics and Mechanics AS ArmSSR)

SUBMITTED: February 28, 1961

29067
S/179/61/000/004/011/019
E081/E335

10.6300

AUTHORS: Ambartsumyan, S.A. and Bagdasaryan, Zh. Ye. (Yerevan)

TITLE: The stability of orthotropic plates in a supersonic gas current

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Mekhanika i masinostroyeniye. no. 4, 1961, pp. 91 - 96

TEXT: The paper is a continuation of previous work (Ref. 1 - Izv.AN SSSR, OTN, 1958, no. 5; Ref. 2 - PMM, 1960, v. 24, no. 2; Ref. 8 - Izv. AN SSSR, OTN, 1960, no. 1). The problem is formulated in rectangular coordinates α, β and γ, such that the α and β directions coincide with the sides of the plate. The thickness of the plate h is constant. One plane of elastic symmetry is parallel to the middle surface of the plate and the other two planes of symmetry are parallel with the sides. A supersonic gas current of velocity u flows over one side of the plate in the α direction. It is assumed that: 1) the normal displacements in the direction of the plate thickness are invariable; 2) the shear stresses $\tau_{\alpha\gamma}$ and $\tau_{\beta\gamma}$

Card 1/3

have the form:

$$\tau_{\alpha\gamma} = f(\gamma)\varphi(\alpha,\beta), \quad \tau_{\beta\gamma} = f(\gamma)\psi(\alpha,\beta) \qquad (1.1)$$

where $\varphi(\alpha,\beta)$ and $\psi(\alpha,\beta)$ are initial functions, and $f(\gamma)$ is a function characterising the law of change of shear stress in the thickness direction, subject to the condition $f(\pm h/2) = 0$; 3) that the normal stress σ_γ is negligibly small compared with the remaining stresses; 4) the excess pressure due to the flowing gas is given by the piston theory; 5) only those nonlinear terms are retained which are connected with the normal displacement w. On the above basis, the nonlinear differential equations for the motion of the plate are established in terms of the elastic constants, the deflection w, the stress function and the functions characterising transverse shear. These equations are solved approximately by a variational method for a plate having all its edges simply supported and subjected to normal forces p_α, p_β acting in

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AUTHORS: Ambartsumyan, S.A., Bagdasaryan, Zh.Ye. (Yerevan)

TITLE: The stability of nonlinearly elastic three-ply plates in a supersonic gas stream

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Mekhanika i mashinostroyeniye. no.5, 1961, 96-99

TEXT: The paper is a continuation of previous examinations of the subject (Ref.4: Ambartsumyan, S.A. Izv. AN SSSR, OTN, 1960, no.6) and deals with the stability of rectangular three-ply plates which are subject to a supersonic gas stream at zero angle of attack. Surplus gas pressure is catered for approximately by the "piston theory" (Ref.3: Chernyy G.G. Flow of gas with a high supersonic speed. Fizmatgiz, 1959). The plates are symmetrical. The following are assumed:

1. The hypothesis of undeformed normals applies to the complete specimen of layers as a whole.
2. The material of each layer of the plate is incompressible.
3. The tensor stress and strain components in each layer coincide.

Card 1/3

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APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000101220007-8"

4. The nonlinear relation between the stress components T_i and the strain components E_i is

$$T_i = a_i E_i - b_i E_i^{mi}$$

where i is the number of layers; a_i, b_i and m_i are constants determined from simple tests of the material of the layers in tension and compression.

On the basis of these assumptions, the basic differential equation for the movement of the plate is quoted and reduced to a system of ordinary differential equations by applying the Bubnov-Galerkin method. As an example, a hinge supported endless strip is examined and it is shown that the amplitude of steady flutter vibrations may be determined by a velocity parameter V, and a parameter Q, which depends on the properties and construction of the plate. It is shown that there is a critical value of ν below which, when Q is larger than zero, the amplitude decreases with an increase of ν. Above this value, when Q is smaller than zero, the amplitude increases with increasing ν. There are

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The stability of nonlinearly ...

4 figures and 6 references: 5 Soviet-bloc and 1 non-Soviet-bloc. The reference to an English language publication reads as follows: Ref.6: Prager W. On ideal locking materials. Trans. Soc. Rheology, 1957, 1.

ASSOCIATION: Institut matematiki i mekhaniki AN ArmSSR (Institute of Mathematics and Mechanics AS Armenian SSR)

SUBMITTED: April 24, 1961

X

Card 3/3

89489

10.9100
16.7300
S/022/61/014/001/009/010
B112/B202

AUTHOR: Ambartsumyan, S. A.

TITLE: Axisymmetrical problem of a thr-layered cylindrical shell consisting of nonlinearly elastic materials

PERIODICAL: Izvestiya Akademii nauk Armyanskoy SSR. Seriya fiziko-matematicheskikh nauk, v. 14, no. 1, 1961, 105-109

TEXT: The author studies circularly cylindrical shells consisting of three nonlinearly elastic layers. The layers are symmetrically arranged with respect to the central surface of the shell. The system of lines of curvature and normals of the central surface is a very appropriate system of coordinates of the cup. Therefore, it is used as reference system. The author assumes that the shell as a whole is not subject to normal deformation and that no axial stress component occurs. The following is assumed for the individual layers: they are incompressible, the main axes of the stress tensor and the deformation tensor coincide, and the relation between stress intensity T_i and deformation intensity E_i is nonlinear:

Card 1/2

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$$T_i = a_i E_i - b_i E_i^{m_i}$$

a; b; m are constants of the i-th layer which were determined by material experiments. A nonlinear fourth-order differential equation is obtained for the normal displacement w of the central surface of the shell. In the special case of a shell with linearly elastic boundary layers and nonlinearly elastic central layer this differential equation can be solved by the method of Budnov-Galerkin in first approximation by $w = C \sin(\pi\alpha/l)$. l is the length of the shell, α the circular coordinate, the constant C is the root of a cubic equation. Finally, the method is illustrated by a numerical example. There are 2 figures, 1 table, and 4 Soviet-bloc references.

ASSOCIATION: Institut matematiki i mekhaniki AN Armyanskoy SSR (Institute of Mathematics and Mechanics AS Armyanskaya SSR)

SUBMITTED: November 16, 1960

26135
S/040/61/025/004/014/021
D274/D306

24.4200 1327, also 2607, 2807

AUTHORS: Ambartsumyan, S.A. and Gnuni, V. Ts. (Yerevan)

TITLE: On the dynamic stability of nonlinear-elastic sandwich plates

PERIODICAL: Prikladnaya matematika i mekhanika, v. 25, no. 4, 1961, 746-750

TEXT: The plate is referred to an orthogonal coordinate-system α, β, γ so that the middle surface coincides with the $\alpha\beta$ -plane. Certain assumptions are made with regard to stress and strain tensors. The equations for the normal displacement w are set up. Further, the dynamic stability equation is obtained. The solution of this equation is sought in the form

$$w = f(t) X(\alpha) Y(\beta) \quad (2.3)$$

where f is the sought-for function and X and Y are chosen so as to satisfy the boundary conditions. Using the Bubnov-Galerkin method, a nonlinear differential equation for f is obtained. Under certain assumptions and taking into account linear damping, this equation

Card 1/4

On the dynamic stability...

reduces to $$f'' + 2\varepsilon_* f' + \Omega_*^2 (1 - 2\mu \cos \theta t) f + V(f, f', t) = 0 \quad (3.4)$$

where
$$\Omega_* = \Omega \frac{\theta}{\theta_*}, \qquad \varepsilon_* = \varepsilon \frac{\theta}{\theta_*} \quad (3.5)$$
$$V(f,f',t) = 2(\varepsilon - \varepsilon_*) f' + (\Omega^2 - \Omega_*^2)(1 - 2\mu \cos \theta t) f - \alpha_1 |f|^{m_1 - 1} f - \alpha_2 |f|^{m_2 - 1} f$$

The critical frequency θ_* is determined by the assumption that the initial unperturbed state is not deformed. Thus, e.g., at the boundaries of the principal region of instability:
$$\theta_*^2 \approx 4\Omega^2 \left(1 \mp \sqrt{\mu^2 - \frac{4\varepsilon^2}{\Omega^2}}\right) \quad (3.6)$$

For $\theta = \theta_*$, the linear part of Eq. (3.4) allows periodic solutions, which are given by the following estimates
$$\varphi_1(t) \approx \cos\left(\frac{\theta t}{2} - \sigma\right), \quad \varphi_2(t) \approx \sin\left(\frac{\theta t}{2} - \sigma\right) \quad \sigma \approx \frac{1}{2} \arcsin \frac{\theta^3 \varepsilon_*}{4\mu\Omega_*^2} \quad (3.7)$$

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S/040/61/025/004/014/021
D274/D306

On the dynamic stability...

By means of L.I. Mandel'shtam's method, the amplitude C of the steady-state oscillations at the boundaries of the principal instability-region can be determined in the zeroth approximation from

$$\int_0^{2T} V[C\varphi_i(t), C\varphi_i'(t), t]\,\varphi_i(t)\,dt = 0 \qquad (3.8)$$

Whence the nonlinear algebraic equation

$$A_1C^m + A_2C^m = (\Omega^2 - \Omega_*^2)(1 \mp \mu\cos 2\sigma)\,C \qquad (3.9)$$

where

$$A_i = \frac{i\theta}{2\pi}\int_0^{2T}\left|\cos^{m_i+1}\left(\frac{\theta t}{2} - \sigma\right)\right|dt, \text{ or } A_i = \frac{\alpha_i\theta}{2\pi}\int_0^{2T}\left|\sin^{m_i+1}\left(\frac{\theta t}{2} - \sigma\right)\right|dt \qquad (3.10)$$

It is shown that the negative sign in the right-hand side of (3.9) refers to the lower-, and the positive sign to the upper boundary of the region of instability. It is also shown that the coefficients A_i vanish if the corresponding layer of the plate is made of linear-

Card 3/4

26135
S/040/61/025/004/014/021
D274/D306

elastic material. Fig. 5 shows an amplitude vs. frequency plot of steady-state oscillations in the principal instability region, when $A_i \geq 0$. Fig. 4 shows such a graph for $A_i \leq 0$. If the two coefficients A_1 and A_2 are of opposite sign, the corresponding two terms of (3.9) will have opposite effects on the frequency of oscillations. 2 examples are given for illustration of Eq. (3.9). There are 7 figures and 5 references: 4 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English-language publication reads as follows: W. Prager, On ideal locking materials. Transactions of the Society of Rheology. 1957, 1.

ASSOCIATION: Institut matematiki i mekhaniki AN ASSR (Institute of Mathematics and Mechanics AS ArmSSR)

SUBMITTED: April 22, 1961

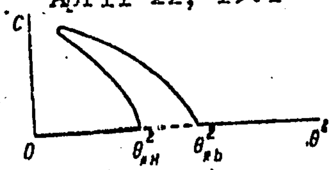

Fig. 4

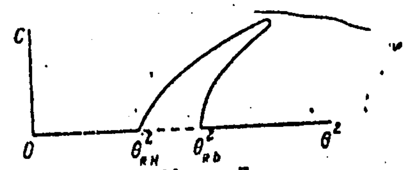

Fig. 5

AMBARTSUMYAN, S.A.; DURGAR'YAN, S.M.

Nonsteady temperature problems of an orthotropic plate. Dokl. AN Arm. SSR 33 no.4:145-149 '61. (MIRA 15:1)

1. Institut matematiki i mekhaniki Akademii nauk Armyanskoy SSR.
2. Chlen-korrespondent AN Armyanskoy SSR (for Ambartsumyan).
(Elastic plates and shells)

SAVIN, G.N., otv.red.; ADADUROV, R.A., red.; ALUMYAE, N.A., red.; AMBARTSUMYAN, S.A., red.; AMIRO, I.Ya., red.; BOLOTIN, V.V., red.; VOL'MIR, A.S., red.; GOL'DENVEYZER, A.L., red.; GRIGOLYUK, E.I., red.; KAN, S.N., red.; KARMISHIN, A.V., red.; KIL'CHEVSKIY, N.A., red.; KISELEV, V.A., red.; KOVALENKO, A.D., red.; MUSHTARI, Kh.M., red.; NOVOZHILOV, V.V., red.; UMANSKIY, A.A., red.; FILIPPOV, A.P., red.; LISOVETS, A.M., tekhn. red.

[Proceedings of the Second All-Union Conference on the Theory of Plates and Shells] Trudy Vsesoiuznoi konferentsii po teorii plastin i obolochek. 2d, Lvov, 1961. Kiev, Izd-vo Akad.nauk USSR, 1962. 581 p. (MIRA 15:12)

1. Vsesoyuznaya konferentsiya po teorii plastin i obolochek. 2, Lvov, 1961.

(Elastic plates and shells)

S/879/62/000/000/039/088
D234/D308

AUTHORS: Ambartsumyan, S. A., Bagdasaryan, Zh. Ye. and Gnuni, V. Ts. (Yerevan)

TITLE: Some dynamical problems of anisotropic three-layer shells

SOURCE: Teoriya plastin i obolochek; trudy II Vsesoyuznoy konferentsii, L'vov, 15-21 sentyabrya 1961 g. Kiev, Izd-vo AN USSR, 1962, 254-259

TEXT: The authors consider a thin shell whose layers are uniform, orthotropic and symmetrical with respect to the middle surface. The material of each layer obeys the generalized Hooke's law. Normal displacements are assumed to be comparable with the thickness and not to vary along the thickness. The complete system of differential equations in terms of 5 unknown functions is formulated; it is essentially simplified if the effect of normal stress is neglected. This system can be applied to problems of nonlinear dynamical stability or aeroelasticity if appropriate substitutions are made.

Card 1/1

39809

S/179/62/000/003/009/015
E191/E435

10.6400

AUTHORS: Ambartsumyan, S.A., Durgar'yan, S.M. (Yerevan)

TITLE: Some nonstationary temperature problems for the orthotropic plate

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Mekhanika i mashinostroyeniye, no.3, 1962, 120-127

TEXT: A homogeneous orthotropic rectangular plate is considered wherein the principal directions of stiffness are parallel to the edges of the plate. The first problem treated is that of a plate, initially at zero temperature, which is subject to heating by maintaining a given constant temperature of the boundary planes constituting the four edge faces. In the analysis, use is made of a hypothesis attributed to Franz Neumann which leads to a generalized Hooke's law for the temperature problem. The analysis leads to the derivation of the field of the stress function. A numerical example describes a square plate (40 cm per side) made of moulded fibreglass laminations. The thickness of the plate does not enter into the problem. The principal stresses after

Card 1/2

...skoy SSR
... and Mechanics
... 1, 1961 AS Armenian SSR)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000101220007-8

L 26053-65 EWT(l)/EWT(w)/EWT(m)/EWA [illegible] IP

ACCESSION NR: AP [illegible]

19
10
B

AUTHOR: Ambartsumyan, S. A. (Yerevan)

TITLE: On the problem of orthotropic plate oscillations placed in a high-temperature [illegible]

SOURCE: AN SSSR. Izv. Otd. tekh. [illegible] yeniye, no. 4, 1963, 133-137

TOPIC TAGS: Hooke system, plate oscillation, elastic medium, elastic modulus, partial differential equation

ABSTRACT: An orthotropic plate of constant thickness h in a Cartesian coordinate system obeying the general Hooke's law where at every point there exist three planes of elastic symmetry is considered. The temperature [illegible] in the plate is defined by T = T (z,t). It is further assumed that the [illegible] hypotheses hold. The stress equations then yield

$$\sigma_x = B_{11}\varepsilon_1 + B_{12}\varepsilon_2 + z(B_{11}\varkappa_1 + B_{12}\varkappa_2) - \beta_1 T$$
$$\sigma_y = B_{22}\varepsilon_2 + B_{12}\varepsilon_1 + z(B_{22}\varkappa_2 + B_{12}\varkappa_1) - \beta_2 T$$
$$\tau_{xy} = B_{66}\omega + 2zB_{66}\tau$$

where $B_{11} = \frac{E_1}{1-\nu_1\nu_2}$, $B_{22} = \frac{E_2}{1-\nu_1\nu_2}$, $B_{12} = \frac{\nu_2 E_1}{1-\nu_1\nu_2} = \frac{\nu_1 E_2}{1-\nu_1\nu_2}$, $B_{66} = G_{12}$

$$\beta_1 = B_{11}\alpha_1 + B_{21}\alpha_2 .$$

L 26053-65

ACCESSION NR: AP3004808

The α_i are linear coefficients of expansion. The equations of motion of the plate element are then written together with the expressions for internal moments and forces, and a set of three partial differential equations is obtained for displacements u, v, and w. In these equations the C_{ik}, D_{ik} and K_{ik} are functions of time only. The temperature dependence of the elasticity moduli is given by

$E_i = E_i^* - E_i^{*} T, \quad G_{12} = G_{12}^* - G_{12}^* T \quad (i = 1, 2)$ or $E_i = E_i' - E_i'' T^2, \quad G_{12} = G_{12}' - G_{12}'' T^2.$

It is assumed that the plate undergoes transverse oscillations with mean temperature variations $T = At, \; A = T_{max} t_1^{-1} \; (0 < t < t_1); \quad T = T_{max} = At_1 \; (t > t_1)$. The resulting equations are then integrated with boundary conditions; $w = 0, \; \partial^2 w / \partial x^2 = 0$ at $x = 0$ and $x = l$ and initial conditions; $w = \varphi(x), \; \partial w/\partial t = \psi(x)$ at $t = 0$. The solution, obtained by using the method of separation of variables, shows that increasing the time t raises the amplitude as well as the [illegible] of the heated plate. Orig. art. has: 47 equations.

ASSOCIATION: Institut matematiki i mekhaniki AN Armyanskoy SSR (Institute of Mathematics and Mechanics, AN Armenian SSR)

SUBMITTED: 20Feb63 ENCL: 00 SUB CODE: ME, AS

NO REF SOV: 008 OTHER: 001

Card 2/2

AMBARTSUMYAN, S.A., BURGARYAN, S.M.

Some problems of temperature and creep of anisotropic sandwich plates and shells.

Report to be submitted for the Shell Structures, International Association for (IASS) Symposium on Non-Classical Shell Problems Warsaw, Poland, 2-5 Sept 63

AMBARTSUMYAN, S.A. (Yerevan)

Stability of inelastic plates allowing for deformations due to transverse shear. Prikl. mat. i mekh. 27 no.4:753-757 Jl-Ag '63. (MIRA 16:9)

1. Institut matematiki i mekhaniki AN Armyanskoy SSR.
(Shear (Mechanics)) (Plasticity)

AMBARTSUMYAN, S.A. (Yerevan)

"The development of the theory of anisotropic sandwich shells"

report presented at the 2nd All-Union Congress on Theoretical and Applied Mechanics, Moscow, 29 January - 5 February 1964

DURGAR'YAN, S. M.; AMBARTSUMYAN, S. A.

"Some problems of vibrations and stability of elastic orthotropic shells and plates in an alternating temperature field."

report submitted for 11th Intl Cong of Applied Mechanics, Munich, W. Germany, 30 Aug-5 Sep 64.

/EWT(1)/EWT(m)/FCS(k)/EWA(d)/EWA(1)/

/0082

ACCESSION NR: AP5002595

Ambartsumyan, S. A. (Yerevan); Bagdasaryan, G. Ye. (Yerevan)

temperature field

TITLE: Flutter of a cylindrical

SOURCE: AN SSSR. Izvestiya. Mekhanika i mashinostroyeniye, no. 5, 1964, 77-82

TOPIC TAGS: cylindrical shell, cylindrical shell flutter, shell flutter speed, infinite plate, flutter speed, plate flutter, plate flutter speed

ABSTRACT: The flutter of an infinite circular cylindrical shell in a ... is analyzed. It is longitudinal supersonic ... assumed that only the elasticity moduli ... is based on the ... with the time-dependent temperature ... Kirchhoff-Love hypothesis on preservation of normals and on the Neumann hypothesis on the absence of shear in an infinitely small shell element subjected to temperature variation; conventional simplifications of the theory of shells with a large index of variation are used. An expression for determining the critical flutter speed at any instant

Card 1/2

L 21114-65
ACCESSION NR: AP5002595

of a given time interval is derived for the case when the elasticity modulus varies linearly with temperature and the temperature linearly with time. The procedure of extending the results obtained to an infinite plate is indicated and formulas for the flutter speed are deduced. Orig. art. has: 39 formulas.

ASSOCIATION: none

SUBMITTED: 14Apr64 ENCL: 00 SUB CODE: AS, ME

NO REF SOV: 010 OTHER: 001 ATD PRESS: 3364

Card 2/2

L 52597-65

... problems in the development of the theory of anisotropic laminated ...

... Izvestiya. ...

TOPIC TAGS: shell structure

... This is a review devoted ...

L 52597-65
ACCESSION NR: AP5015721

Shells; Questions on the Stability and Vibrations of Anisotropic Laminated [illegible]; The Temperature Problem. [illegible] ries of An[illegible]

[illegible]

Card 2/2

L 52597-65

ACCESSION NR: AP5015721

This paper was delivered at the Second All-Union Congress on Theoretical and Applied Mechanics.

Orig. art. has 3 figures and 16 formulas.

ASSOCIATION: Institut matematiki i mekhaniki AN Armyanskoy SSR (Institute of [illegible]

SUBMITTED: 30Mar64 ENCL: 00 SUB CODE: AS

NO REF SOV: 100 OTHER: 018 JPRS

Card 3/3

S/0252/64/038/002/0087/0092

ACCESSION NR: AP4033061

AUTHORS: Ambartsumyan, S. A. (Corresponding member); Durgar'yan, S. M.

TITLE: Oscillations of an orthotropic slanting shell in a variable temperature field

SOURCE: AN ArmSSR. Doklady*, v. 38, no. 2, 1964, 87-92

TOPIC TAGS: variable temperature field, orthotropic shell, slanting shell, free oscillation, positive Gaussian curvature, generalized Hook law, heat equation, elasticity modulus, shear modulus, linear expansion coefficient

ABSTRACT: The authors study a very slanted, orthotropic shell, whose material is subject to a generalized Hook's law, referred to an orthogonal curvilinear coordinate system α, β, γ. At each point there are three planes of elastic symmetry parallel to the coordinate surfaces. The authors are concerned with free oscillations of the shell which has positive Gaussian curvature and constant thickness h, in the field of influence of high temperatures. The following assumptions are made: the shell temperature $T = T(\gamma, t)$ satisfies an initial condition ($t = t_0$) and surface conditions and the heat equation; in the first

AUTHORS: Ambartsumyan [illegible]

TITLE: Flutter in a plate in a temperature field

SOURCE: AN ArmSSR. Doklady, v. 39, no. 3, 1964, 141-147

TOPIC TAGS: flutter, flat plate, thermal stress, vibration [illegible] supersonic [illegible] ration, [illegible] velocity

ABSTRACT: The article deals with an isotropic plate of constant thickness, oriented in a [illegible] the midplane of the [illegible] ordinate plane xy. It is assum[illegible] with the [illegible] of the materia[illegible] [illegible] gas, with unperturbed velocity directed along the ox axis, is assumed

Card 1/3

L 26335-65

ACCESSION NR: AP5002648

to flow around the plate. The authors solve the differential equation of motion of this plate under certain assumptions concerning zero deformation in the normal direction, zero shear due to change in temperature in an infinitesimally small element of the plate, and the "law of plane sections" in the determination of the aerodynamic pressure. It is shown that the time behavior of the displacement (the flutter) depends both on the velocity of the incoming stream and on the variation of the modulus of elasticity with time and temperature. An analysis of all these factors shows that the dynamic critical velocity of the flutter is smaller than the critical velocity obtained from the quasistatic theory, and in the case of sufficiently small damping the difference between the two can be quite large. Orig. art. has: 37 formulas.

ASSOCIATION: Institut matematiki i mekhaniki Akademii nauk Armyanskoy SSR (Institute of Mathematics and Mechanics, Academy of Sciences ArmSSR)

Card 2/3

L 26335-65

ACCESSION NR: AP5002648

0

SUBMITTED: 02Apr64 ENCL: 00 SUB CODE: AS, ME

NR REF SOV: 008 OTHER: 001

L 29341-65 EWT(1)/EPF(n)-2 Pu-4 WW

S/0179/64/000/006/0117/0119

15

B

ACCESSION NR: AP5005179

AUTHORS: Ambartsumyan, S. A. (Yerevan); Gnuni, V. Ts. (Yerevan)

TITLE: Parametric oscillations of a flexible plate in high temperature fields

SOURCE: AN SSSR. Izvestiya. Mekhanika i mashinostroyeniya, no. 6, 1964, 117-119

TOPIC TAGS: flexible plate, high frequency vibration, temperature field, variational calculus, resonant state

ABSTRACT: Consider a flexible isotropic plate of thickness h in a Cartesian coordinate system. The rectangular plane of the plate is hinged around its perimeter and is subjected to a high-frequency longitudinal load

$$p_x = P\cos\theta t$$

and temperature $T = T(z, t) = T(-z, t)$. The elasticity modulus E is assumed to be a function of the temperature. The equations of dynamic stability are obtained on the bases of the hypotheses that normal displacements are comparable to the plate thickness, that the plate normal does not deform, and that temperature changes in a differential element do not induce displacements. For an approximate solution,

Card 1/2

L 29541-65

ACCESSION NR: AP5005179

it is assumed that, during a principal parametric resonance period, the heated plate oscillates according to the law

$$f = C_{jk}\varphi_k(t)$$

where

$$\varphi_1 = \cos [illegible], \quad \varphi_2 = [illegible].$$

Using the Galerkin-Bubnov variational principle, the result obtained is

$$C_{jk}^2 = \frac{1}{3}\left[\gamma(t_j) + 2\gamma_1 \frac{\pi}{\theta} [illegible] \theta^2 - \theta_{*}^2(t_j) - \delta_1 \frac{\pi}{\theta}\right].$$

The case is considered where the changes in E are very large. This condition gives rise to a quasi-static problem in the temperature sense. A solution for C_{jk}^{ζ} is also given for the conditions

$$E = E_0 - eT, \quad T = B(z)t^2 \quad E = E_0 - e_1t^2, \quad e_1 = eB(z),$$

Orig. art. has: 24 equations.

ASSOCIATION: none

SUBMITTED: 12Jun64 | ENCL: 00 | SUB CODE: AS

NO REF SOV: 007 | OTHER: 000

Card 2/2

SOURCE: AN SSSR. Izvestiya. Mekhanika, no. 4, 1965, 77-85

TOPIC TAGS: cylindrical shell, different elasticity moduli material, unequal strength elasticity theory, shell stress, shell deformation

ABSTRACT: Before starting to discuss the problem, the elasticity relationships are derived for thin shells made of material with different strength ...

Card 1/3

L 65020-65

ACCESSION NR: A[illegible]

First, the stre[illegible] distributions are analyzed separately in the longitudinal and circumferential [illegible], then the [illegible] is dis- [illegible] ments and [illegible]

zation of the problem in some aspects, [illegible] information [illegible] strength [illegible] elastic [illegible]

Card 2/3

4182

Card 3/3 mlb

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000101220007-8"

NAZAROV, Armen Georgiyevich; AMBARTSUMYAN, S.A., akademik, otv.red.; ZAVRIYEV, K.S., akademik, retsenzent; NAPETVARIDZE, Sh.G., prof., retsenzent

[Mechanical similitude of solid deformable bodies; the theory of simulation] O mekhanicheskom podobii tverdykh deformiruemykh tel; k teorii modelirovaniia. Erevan, Izd-vo AN Arm. SSR, 1965. 217 p. (MIRA 18:10)

1. AN Gruzinskoy SSR (for Zavriyev). 2. AN Armyanskoy SSR (for Ambartsumyan).

L 06223-67 EWT(d)/EWT(m)/EWP(w)/EWP(t)/ETI IJP(c) JD/EM

ACC NR: AP6024189 SOURCE CODE: UR/0424/66/000/002/0044/0053

AUTHORS: Ambartsumyan, S. A. (Yerevan); Khachatryan, A. A. (Yerevan)

ORG: Institute of Mathematics and Mechanics, AN Armenian SSR (Institut matematiki i mekhaniki AN Armyanskoy SSR)

TITLE: Basic equations of the theory of elasticity for materials resisting both extension and compression

SOURCE: Inzhenernyy zhurnal. Mekhanika tverdogo tela, no. 2, 1966, 44-53

TOPIC TAGS: elastic theory, Hookes Law, stress analysis, material deformation, material strength

ABSTRACT: An attempt is made to derive the basic equations and relationships of the theory of elasticity for materials resisting both extension and compression. It is noted that the modulus of elasticity may differ for the same material in compression and in tension and that the Poisson coefficients for each case may also differ. A Cartesian coordinate system is used to state the problem. For example, the stress equilibrium condition is given as

$$\begin{aligned} &\sigma_{x,x} + \tau_{xy,y} + \tau_{xz,z} + X = 0, \quad \tau_{xy} = \tau_{yx} \\ &\tau_{yx,x} + \sigma_{y,y} + \tau_{yz,z} + Y = 0, \quad \tau_{xz} = \tau_{zx} \\ &\tau_{zx,x} + \tau_{zy,y} + \sigma_{z,z} + Z = 0, \quad \tau_{yz} = \tau_{zy}, \end{aligned}$$

Card 1/2

L 06222-67

ACC NR: AP6024189

where σ_i, τ_{ik} are normal and tangential stresses, and X, Y, Z are global force components. Cyclic permutation of these equilibrium conditions allows the remaining conditions to be written in xyz. Additional equations are given in definition of deformation and geometric relationships. Hooke's Law is applied to the analysis of a volume element, and the deformation of the element is studied for the case of compressive principal stresses and for tensile tertiary stress. Deflections are analyzed in reference to a rotated coordinate system. The Lamé equations are derived, and the solution for these equations stems from consideration of the strain continuity leading to the Beltram relationships. An analytic expression for the shear modulus is found. The analysis is also extended to the case of a hollow cylinder in torsion. Orig. art. has: 65 equations and 2 figures.

SUB CODE: 11, 12, 20/ SUBM DATE: 09Dec65/ ORIG REF: 004

Card 2/2 LC

ACC NR: AP7002693 SOURCE CODE: UR/0424/66/000/006/0064/0067

AUTHOR: Ambartsumyan, S. A. (Yerevan); Khachatryan, A. A. (Yerevan)

ORG: none

TITLE: On the "bi-modular" elasticity theory

SOURCE: Inzhenernyy zhurnal. Mekhanika tverdogo tela, no. 6, 1966, 64-67

TOPIC TAGS: elasticity theory, elastic modulus, [redacted]

ABSTRACT: Certain problems of elasticity theory, applied to "bi-modular" materials which possess different moduli (strengths) in tension and compression are discussed, and the validity of some formulas and theorems of this theory for "bi-modular" materials is proved. The generalized law of elasticity in the "bi-modular" theory is examined in a case when one of principal stresses has a sign different from the signs of the other principal stresses, and the directions of principal stresses do not coincide with the orthogonal coordinate axes. Expressions for the specific potential strain energy of a body made of a "bi-modular" material are derived in terms of stresses and in terms of strains, thus proving that the Clapeyron formula is valid for these materials. It is also proved that the Castigliano formulas are valid for "bi-modular" materials. The Clapeyron formula for the potential strain energy in stresses and strains is also

ACC NR: AP7002693

given in another form by using the Green and Castigliano formulas. It is also indicated how it is possible to prove the validity of the Clapeyron theorem, the Lagrange and Castigliano equations in variations for the discussed "bi-modular" materials. Orig. art. has: 29 formulas.

SUB CODE: 20/ SUBM DATE: 27Jun66/ ORIG REF: 004/
ATD PRESS: 5113

Card 2/2

PAPOYAN, S.A., starshiy nauchnyy sotrudnik; AMBARTSUMYAN, S.G.

Osteogenic sarcomas induced by radioactive strontium-90 and the possibility of their utilization for experimental chemotherapy. Vop. radiobiol. [AN Arm. SSR] 1:137-139 '60. (MIRA 15:3)

1. Iz Instituta tentgenologii i onkologii i Sektora radiobiologii AN Armyanskoy SSR.

(CHEMOTHERAPY) (STRONTIUM--ISOTOPES)
(BONES--CANCER)

PAPOYAN, S.A., starshiy nauchnyy sotrudnik; KHEROBYAN, F.A., starshiy nauchnyy sotrudnik; AMBARTSUMYAN, S.G.

X-ray characteristics of the osteogenic sarcomas caused by radioactive strontium 90 in rats. Vop. radiobiol. [AN Arm. SSR] 1:141-147 '60. (MIRA 15:3)

1. Iz Instituta rentgenologii i onkologii i Sektora radiobiologii AN Armyanskoy SSR.

(STRONTIUM--ISOTOPES)
(BONES--CANCER)

ARUTYUNYAN, R.K., kand. biolog. nauk; AMBAHTSUMYAN, S.G., mladshiy nauchnyy sotrudnik

N.E. Vvedenskii's optimum and pessimum phenomena in the cerebral cortex of rabbits following radiation injury. Vop. radiobiol. [AN Arm. SSR] 3/4:173-178 '63.
(MIRA 17:6)

ARTYUNYAN, R.K., kand. biol. nauk; GABRIELYAN, A.A., mladshiy nauchnyy sotrudnik; AMBARTSUMYAN, S.G., mladshiy nauchnyy sotrudnik

Effect of direct current on the blood catalase activity in irradiated rats. Vop. radiobiol. [AN Arm. SSR] 3/4:289-291 '63. (MIRA 17:6)