PROBLEM OF AN ANISOTROPIC PLATE WEAKENED BY CURVILINEAR CRACKS AND REINFORCED BY STIFFENERS

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Boundary-value problems for an isotropic plane with curvilinear slits have been examined earlier (see [1-3]). The extension to the anisotropy case is given in [4, 5].

To reduce the possibility of the beginning of rupture and to prevent crack propagation, reinforcment of structure elements by stiffeners is used extensively. The problem of the influence of the ribs on the stress distribution in an isotropic plate with rectilinear cracks was examined in [6-12].

A general system of integral equations is constructed in this paper, for an elastic anisotropic plate weakened by a finite number of curvilinear slits that are loaded along the edges by self-equilibrating external forces, and reinforced by a finite number of ribs, and a direct algorithm for the numerical solution is proposed.

1. Let us consider the problem of the stress-strain state of an infinite anisotropic plate weakened by through curvilinear slits L_j $(j = \overline{1, k})$, each of which is a smooth arc, and reinforced along the rectilinear segments l_s $(s = \overline{1, m})$ by stiffeners. Let us use the notation $L = \bigcup_{j=1}^{k} L_j$, $l = \bigcup_{s=1}^{m} l_s$. We direct the normal n to the right for the positive direction of bypassing the line L, l (Fig. 1).

At infinity the plate is subjected to uniform tension σ_x^∞, σ_y^∞ and shear τ_{xy}^∞. A self-equilibrated continuous load $X_n^\pm(t) + iY_n^\pm(t) \in H^*$ $(t = x + iy \in L,$ is given on the slit edges (the plus refers to the left edge of the slit L_j). The rib l_s is loaded at the end z^{0s} by a force P_s whose direction is opposite to the vector $e^{i\vartheta_s}$.

Let us assume that the size of the rib cross section and the thickness of the plate h are small compared to the length of the clamped section; the plate is in a generalized plane stress state; the rib is continuously attached to the plate and operates as a one-dimensional elastic continuum.

Let $r(t) = \{r_s(t) | t \in l_s\}$ be the contact forces occurring in the plate due to the ribs, and let us consider r(t) as volume forces in the plate (the positive direction for $r_s(t)$ agrees with the direction of the force P_s).

Find two analytic functions $\Phi_\nu(z_\nu)$, bounded at infinity and satisfying the boundary conditions [13, 14]

$$a(\psi)\Phi_1^\pm(t_1) + b(\psi)\overline{\Phi_1^\pm(t_1)} + \Phi_2^\pm(t_2) = F^\pm(t), \tag{1.1}$$

$$a(\psi) = \frac{\mu_1 - \bar{\mu}_2}{\mu_2 - \bar{\mu}_2}\,\frac{\mu_1\cos\psi - \sin\psi}{\mu_2\cos\psi - \sin\psi},\quad b(\psi) = \frac{\bar{\mu}_1 - \bar{\mu}_2}{\mu_2 - \bar{\mu}_2}\,\frac{\bar{\mu}_1\cos\psi - \sin\psi}{\mu_2\cos\psi - \sin\psi},$$

$$F(t) = \pm\frac{X_n^\pm(t) + \bar{\mu}_2 Y_n^\pm(t)}{(\mu_2 - \bar{\mu}_2)(\mu_2\cos\psi - \sin\psi)},\quad t \in L;$$

$$h\left(\tau_n^- - \tau_n^+\right) = r(t),\ \sigma_n^+ = \sigma_n^-,\ u^+ = u^-,\ v^+ = v^-,\ t \in l \tag{1.2}$$

and the conditions of equality of the plate and rib strains along the contact line $\varepsilon^+ = \varepsilon^- = \varepsilon_0$ $(t \in l_s)$:

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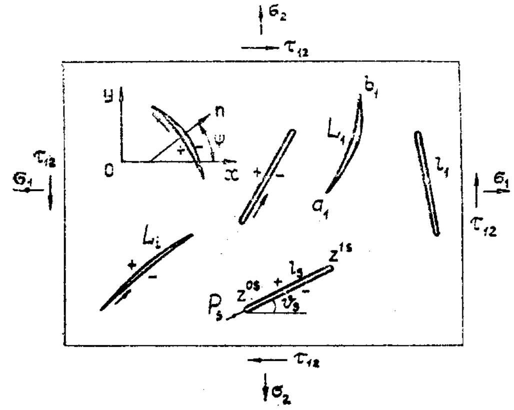

Fig. 1

$$2\,\mathrm{Re}\left\{\sum_{\nu=1}^{2} S_\nu(\vartheta_s)\,\Phi_\nu^{+}(t_\nu)\right\} = \frac{1}{E_s F_s}\int_t^{z^{1s}} r_s(t)\,dl,$$
$$S_\nu(\vartheta) = p_\nu\cos^2\vartheta + r_\nu\cos\vartheta\sin\vartheta + q_\nu\mu_\nu\sin^2\vartheta, \tag{1.3}$$
$$p_\nu = a_{11}\mu_\nu^2 - a_{16}\mu_\nu + a_{12},\ q_\nu = a_{12}\mu_\nu + a_{22}\mu_\nu^{-1} - a_{26},$$
$$r_\nu = a_{16}\mu_\nu^2 + a_{26} - a_{66}\mu_\nu.$$

Here a_{ij} are Hooke's law coefficients; μ_ν, corresponding characteristic numbers; ψ, angle between the normal n at the point $t \in L$ and the axis; $t_\nu = \mathrm{Re}\,t + \mu_\nu \mathrm{Im}\,t$; E_s, F_s, Young's modulus and the cross-sectional area of the s-th rib; $\varepsilon^{\pm}$ $\sigma_n^{\pm}$, $\tau_n^{\pm}$, ultimate values of the relative elongation in the direction l, the normal, and tangential stress to the left and right; and ε_0, rib strain.

2. The functions $\Phi_\nu(z_\nu)$ that yield the solution to the boundary-value problem (1.1) and (1.2) will be sought in the form

$$\Phi_\nu(z_\nu) = \frac{1}{2\pi i}\int_l \frac{A_\nu(t)\,r(t)\,dl}{t_\nu - z_\nu} + \frac{1}{2\pi i}\int_L \frac{\omega_\nu(t)\,dt_\nu}{t_\nu - z_\nu} + B_\nu\quad (\nu = 1, 2), \tag{2.1}$$

where $A_\nu(t)$ are determined from the system of equations $(t \in l_s,\ s = \overline{1, m})$

$$A_1 + A_2 + \bar A_1 + \bar A_2 = \sin\vartheta_s/h,$$
$$\mu_1 A_1 + \mu_2 A_2 + \bar\mu_1\bar A_1 + \bar\mu_2\bar A_2 = -\cos\vartheta_s/h,$$
$$\mu_1^2 A_1 + \mu_2^2 A_2 + \bar\mu_1^2\bar A_1 + \bar\mu_2^2\bar A_2 = \frac{-a_{16}\cos\vartheta_s - a_{12}\sin\vartheta_s}{a_{11}h}, \tag{2.2}$$
$$\frac{A_1}{\mu_1} + \frac{A_2}{\mu_2} + \frac{\bar A_1}{\bar\mu_1} + \frac{\bar A_2}{\bar\mu_2} = \frac{a_{12}\cos\vartheta_s + a_{26}\sin\vartheta_s}{a_{22}h}.$$

The complex functions $\omega_\nu(t) = \{\omega_{\nu j}(t) | t \in L_j,\ j = \overline{1, k}\}$ and the contact interaction forces r(t) are the fundamental unknowns of the problem. The constants B_ν are determined in terms of the values σ_x^∞, σ_y^∞, τ_{xy}^∞.

Since the first integrals in the expressions for $\Phi_\nu(z_\nu)$ from (2.1) yield the solution for an infinite plate without slits loaded by forces r(t) lumped on l [15], then taking account of (2.2), the functions $\Phi_\nu(z_\nu)$ automatically assure compliance with the boundary conditions (1.2).

Using the Sokhotskii—Plemelj formula the conditions (1.1), (2.1) for $\Phi_\nu(z_\nu)$, we obtain $(t \in L)$

$$\omega_2(t) = F_1(t) - a(\psi)\omega_1(t) - b(\psi)\overline{\omega_1(t)}; \tag{2.3}$$

$$a(\psi)\Phi_1(t_1) + b(\psi)\overline{\Phi_1(t_1)} + \Phi_2(t_2) = F_2(t)/2,$$
$$F_1(t) = F^+(t) - F^-(t),\ F_2(t) = F^+(t) + F^-(t). \tag{2.4}$$

Substituting the expression for $\omega_2(t)$ from (2.3) into (2.1) and (2.4), we have a singular integral equation ($\omega(t) = \omega_1(t)$)

$$\frac{1}{\pi i}\int_L \frac{\omega(\tau)\,d\tau_1}{\tau_1 - t_1} + \int_L k_1(t,\tau)\,\omega(\tau)\,dl + \int_L k_2(t,\tau)\,\overline{\omega(\tau)}\,dl + \int_l k_3(t,\tau)\,r(\tau)\,dl = f_1(t),\quad t \in L. \tag{2.5}$$

We obtain the second integral equation by substituting $\Phi_\nu(z_\nu)$ from (2.1) into (1.3) and replacing $\omega_2(t)$ by $\omega_1(t)$ by means of (2.3)

$$\mathrm{Im}\left\{\int_l \frac{f(t,\tau)\,r(\tau)\,dl}{\tau - t} + \int_L k_4(t,\tau)\,\omega(\tau)\,dl + \int_L k_5(t,\tau)\,\omega(\tau)\,dl\right\} + \int_l k_6(t,\tau)\,r(\tau)\,dl = f_2(t),\quad t \in l_s. \tag{2.6}$$

Here $k_j(t,\tau)$ $(j = \overline{1,6})$, $f_j(t)$ $(j = 1, 2)$ are functions of the class H* on L and l, defined by the formulas ($\varphi = \varphi(\tau)$, $\psi = \psi(t)$)

$$k_1(t,\tau) = \frac{1}{2\pi i}\left\{\frac{d}{dl}\ln\frac{\bar{\tau}_2 - \bar{t}_2}{\tau_1 - t_1} + \frac{b(\varphi) - b(\psi)}{b(\psi)(\bar{\tau}_2 - \bar{t}_2)}\frac{d\bar{\tau}_2}{dl}\right\},$$
$$k_2(t,\tau) = \frac{1}{2\pi i}\left\{\frac{\overline{a(\psi)}}{\overline{b(\psi)}}\frac{d}{dl}\ln\frac{\bar{\tau}_2 - \bar{t}_2}{\bar{\tau}_1 - \bar{t}_1} + \frac{\overline{a(\varphi) - a(\psi)}}{(\bar{\tau}_2 - \bar{t}_2)\overline{b(\psi)}}\frac{d\bar{\tau}_2}{dl}\right\},$$
$$k_3(t,\tau) = \frac{1}{2\pi i}\left\{\frac{A_1(\tau)}{\tau_1 - t_1} - \frac{\overline{a(\psi)}}{\overline{b(\psi)}}\frac{\overline{A_1(\tau)}}{\bar{\tau}_1 - \bar{t}_1} - \frac{\overline{A_2(\tau)}}{\overline{b(\psi)}(\bar{\tau}_2 - \bar{t}_2)}\right\},$$
$$k_4(t,\tau) = \frac{S_1(\vartheta)}{\tau_1 - t_1}\frac{d\tau_1}{dl} - \frac{a(\varphi)S_2(\vartheta)}{\tau_2 - t_2}\frac{d\tau_2}{dl},$$
$$k_5(t,\tau) = \frac{b(\varphi)S_2(\vartheta)(t - \tau)}{\tau_2 - t_2}\frac{d\tau_2}{dl}, \tag{2.7}$$
$$k_6(t,\tau) = \frac{\pi}{E_sF_s}\begin{cases}-1, & \tau \in [t, z^{1s}],\\ 0, & \tau \in [z^{0s}, t],\end{cases}$$
$$f_1(t) = \frac{1}{2\overline{b(\psi)}}\left\{\overline{F_2(t)} + \frac{1}{\pi i}\int_L \frac{\overline{F_1(\tau)}\,d\bar{\tau}_2}{\bar{\tau}_2 - \bar{t}_2}\right\}$$
$$- \frac{\sigma_x^\infty \cos\psi + \tau_{xy}^\infty(\mu_2\cos\psi + \sin\psi) + \sigma_y^\infty \mu_2 \sin\psi}{(\mu_1 - \mu_2)(\mu_1\cos\psi - \sin\psi)},$$
$$f_2(t) = -2\pi\,\mathrm{Re}\left\{\sum_{\nu=1}^{2} S_\nu(\vartheta)\,B_\nu\right\} - \mathrm{Im}\left\{\int_L \frac{S_2(\vartheta)\,F_1(\tau)\,d\tau_2}{\tau_2 - t_2}\right\}.$$

The additional constraints

$$\int_{l_s} r(t)\,dl = P_s \quad (s = \overline{1,m}); \tag{2.8}$$

$$\int_{L_j} \omega(\tau)\,d\tau_1 = \frac{2}{a_{11}\Delta}\left\{\mu_1\,\mathrm{Re}\left[p_2\int_{L_j} F_1 d\tau_2\right] - \mathrm{Re}\left[q_2\int_{L_j} F_1 d\tau_2\right]\right\},$$
$$\Delta = (\mu_1 - \mu_2)(\mu_1 - \bar{\mu}_2)(\mu_1 - \bar{\mu}_1), \tag{2.9}$$

which follow from the conditions of equilibrium of the ribs, and single-valuedness of the displacements should be appended to (2.5) and (2.6).

In combination with the additional conditions (2.8) and (2.9), the system of singular equations (2.5) and (2.6) yields the unique solution of the constant problem.

If the plate is weakened by a system of rectilinear cracks arranged along one line, then (2.5) is simplified significantly:

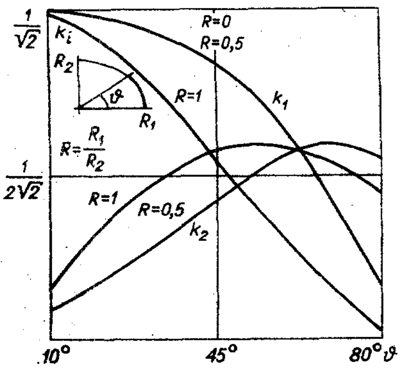

Fig. 2

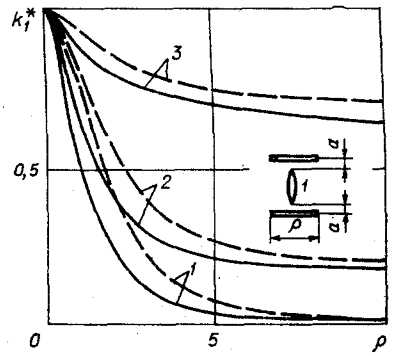

Fig. 3

$$\frac{1}{\pi i}\int_L \frac{\omega(\tau)\,d\tau_1}{\tau_1 - t_1} + \int_l k_3(t,\tau)\,r(\tau)\,dl = f_1(t), \quad t \in L.$$

If there are no ribs, (2.5) and (2.9) go over into equations in [4, 5].

Performing the passage to the limit analogously to [4] in (2.5) and (2.9), we obtain the appropriate equations of the problem for the isotropic plate case.

3. Introducing the change of variables $r_s(t) = h\varphi_s(\beta),\ t \in l_s$,

$$\omega_{\nu j}(t) = \chi_{\nu j}(\beta),\ \chi_{1j}(\beta) = \varphi_{2j-1+m}(\beta) + i\varphi_{2j+m}(\beta),\ t \in L_j,\ -1 < \beta < 1,$$
$$j = \overline{1, k},\ s = \overline{1, m},$$

after some manipulation of (2.5)-(2.7) we obtain a system of singular integral equations

$$\sum_{j=1}^{2k+m}\int_{-1}^{1}\left\{\frac{f_{lj}(\beta_0,\beta)}{\beta-\beta_0} + k_{lj}(\beta_0,\beta)\right\}\varphi_j(\beta)\,d\beta = N_l(\beta_0),$$

and the additional conditions (2.8) and (2.9) take the form

$$\sum_{j=1}^{2k+m}\int_{-1}^{1}\gamma_{lj}(\beta)\,\varphi_j(\beta)\,d\beta = C_l \quad (l = \overline{1, 2k+m}),$$

where we do not present the general form of f_{lj}, k_{lj}, γ_{lj} because of the awkwardness.

Let us note that if the plate is subjected to uniform tension and shear at infinity, is reinforced along the segments $l_s = \{t^s(\beta) = x_s + iy_s + \rho(\beta + 1)/2 \mid -1 < \beta < 1\}$ by stiffeners, and is weakened along the arc $L = \{t(\beta) = x(\beta) + iy(\beta) \mid -1 < \beta < 1\}$ by a slit free of external forces, then $k = 1$, $m = 2$, and

$$f_{jj}(\beta_0,\beta) = 1\ (j = 1, 2),\ f_{12} = f_{21} = f_{14} = f_{13} = f_{23} = f_{24} = 0,$$
$$f_{33} = f_{44},\ f_{34} = -f_{43},\ f_{lj} = 0\ (l = 3, 4,\ j = 1, 2),$$
$$f_{33}(\beta_0,\beta) + if_{43}(\beta_0,\beta) = \frac{2t_1'(\beta)(\beta-\beta_0)}{t_1(\beta) - t_1(\beta_0)},$$
$$A = \operatorname{Im}\left\{\sum_{\nu=1}^{2} p_\nu A_\nu\right\},\ k_{ll}(\beta_0,\beta) = \frac{\pi\rho h}{2E_lF_lA}\begin{cases}0, & \beta < \beta_0,\\ -1, & \beta > \beta_0,\end{cases}\quad l = 1, 2,$$
$$k_{lj}(\beta_0,\beta) = \frac{1}{A}\operatorname{Im}\left\{\sum_{\nu=1}^{2}\frac{p_\nu A_\nu \rho}{t_\nu^j(\beta) - t_\nu^l(\beta_0)}\right\}\ (l \neq j,\ l, j = 1, 2),$$
$$k_{l3}(\beta_0,\beta) = \frac{1}{A}\operatorname{Im}\left\{\frac{p_1 t_1'(\beta)}{t_1(\beta) - t_1^l(\beta_0)} - \frac{p_2[a(\psi) + b(\psi)]\,t_2'(\beta)}{t_2(\beta) - t_2^l(\beta_0)}\right\}(l = 1, 2).$$

TABLE 1

U \ a	1,0		0,1	
	$N=10$	$N=20$	$N=10$	$N=20$
0	0,65601	0,65601	0,23613	0,23062
1	0,66838	0,66835	0,33637	0,33001
10	0,69466	0,69464	0,58037	0,57573

$$k_{l4}(\beta_0, \beta) = \frac{1}{A}\operatorname{Re}\left\{\frac{p_1 t_1'(\beta)}{t_1(\beta) - t_1^l(\beta_0)} - \frac{p_2[a(\psi) - b(\psi)]\, t_2'(\beta)}{t_2(\beta) - t_2^l(\beta_0)}\right\} \quad (l = 1, 2),$$

$$k_{3j}(\beta_0, \beta) + ik_{4j}(\beta_0, \beta) = K_{3j}(\beta_0, \beta) \quad (j = 1, 2),$$

$$K_{3j}(\beta_0, \beta) = \frac{\rho}{2}\left\{\frac{A_1}{t_1^j(\beta) - t_1(\beta_0)} - \frac{\overline{a(\psi_0)}}{\overline{b(\psi_0)}}\,\frac{\bar{A}_1}{\overline{t_1^j(\beta) - t_1(\beta_0)}} - \frac{\bar{A}_2}{\overline{b(\psi_0)}\left[\overline{t_2^j(\beta) - t_2(\beta_0)}\right]}\right\},$$

$$t_\nu^j(\beta) = x_j + \mu_\nu y_j + \frac{\beta + 1}{2}\rho \quad (j = 1, 2), \quad \operatorname{tg}\psi = -\frac{x'(\beta)}{y'(\beta)},$$

$$C_k = 0 \quad (k = \overline{1, 4}), \quad \gamma_{11} = \gamma_{22} = 1, \quad \gamma_{33} = \gamma_{44},$$

$$\gamma_{j1} = \gamma_{1j} = \gamma_{l2} = \gamma_{2l} = 0 \quad (j = \overline{2, 4},\ l = \overline{3, 4}),$$

$$\gamma_{34} = -\gamma_{43}, \quad \gamma_{33}(\beta) + i\gamma_{43}(\beta) = t_1'(\beta),$$

$$N_l(\beta_0) = -\frac{\pi}{A\rho}\left(a_{11}\sigma_x^\infty + a_{12}\sigma_y^\infty + a_{16}\tau_{xy}^\infty\right) \quad (l = 1, 2),$$

$$N_3(\beta_0) + iN_4(\beta_0) = \frac{2\pi i\left\{\sigma_x^\infty \cos\psi_0 + \tau_{xy}^\infty(\mu_2\cos\psi_0 + \sin\psi_0) + \sigma_y^\infty \mu_2 \sin\psi_0\right\}}{(\mu_2 - \mu_1)(\mu_1\cos\psi_0 - \sin\psi_0)}.$$

As is known [16], the desired functions have the form $\varphi_l(\beta) = \varphi_l^0(\beta)(1-\beta^2)^{-1/2}$. Using quadrature formulas for the singular integrals [14, 17], we can write (2.5) and (2.6) in the form

$$\frac{\pi}{N}\sum_{i=1}^{N}\sum_{n=1}^{2k+m}\left\{\frac{f_{ln}(x_j, t_i)}{t_i - x_j} + k_{ln}(x_j, t_i)\right\}\varphi_n^0(t_i) = N_l(x_j),$$
$$x_j = \cos\frac{\pi}{N}j, \quad t_i = \cos\frac{2i-1}{2N}\pi, \quad i = \overline{1, N}, \quad j = \overline{1, N-1}, \quad l, n = \overline{1.2k+m}, \tag{3.1}$$

and the additional conditions (2.8) and (2.9) in the form

$$\frac{\pi}{N}\sum_{i=1}^{N}\sum_{n=1}^{2h+m}\gamma_{ln}(t_i)\,\varphi_n^0(t_i) = C_l, \quad l, n = \overline{1,2k+m}, \quad i = \overline{1, N}. \tag{3.2}$$

The system (3.1) and (3.2) yields (2k + m)N linear algebraic equations in the approximate values of the desired functions $\varphi_l^0(\beta)$ at the Chebyshev nodes $\beta = t_i$ $(i = \overline{1, N})$.

By knowing the solutions of (2.5) and (2.6), we find the asymptotic values of the stresses in the neighborhood of the ends of the cracks L_j from the formulas

$$(-1)^k 2\operatorname{Re}\left\{\sum_{\nu=1}^{2}\mu_\nu^k\Phi_\nu(z_\nu)\right\} = \begin{cases}\sigma_x, & k = 2,\\ \tau_{xy}, & k = 1,\\ \sigma_y, & k = 0,\end{cases} \tag{3.3}$$

$$\Phi_\nu(z_\nu) \approx \frac{1}{2\sqrt{2}}\,\frac{\chi_{\nu j}^0(\mp 1)\sqrt{\pm t_\nu'(\mp 1)}}{\sqrt{z_\nu - c_\nu}} \qquad (j = \overline{1, k}),$$

where the upper sign is taken for $c = a_j$, and the lower for $c = b_j$; $\chi_{\nu j}^0(\beta) = \chi_{\nu j}(\beta)(1-\beta^2)^{1/2}$ [16]. The value of $\chi_{2j}^0(\mp 1)$ in (3.3) is determined in terms of $\chi_{1j}^0(\mp 1)$ by means of (2.3).

4. Results of computations are presented below for a plate from orthtropic material (the anisotropy parameters are $E_1/E_2 = 3$, $E_1/G = 6.24$, $\nu_1 = 0.25$), weakened along an arc seg-

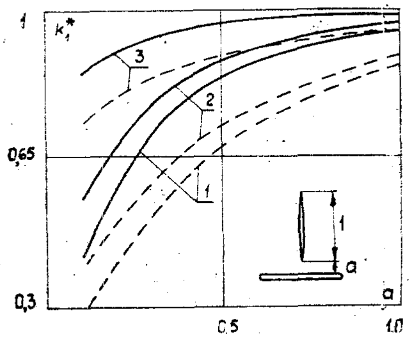

Fig. 4

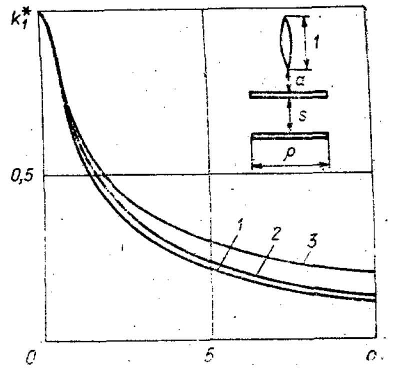

Fig. 5

ment of the ellipse $L=\left\{R_1\cos\frac{\beta+1}{2}\vartheta+iR_2\sin\frac{\beta+1}{2}\vartheta\,|-1<\beta<1\right\}$ by a slit free of external forces and reinforced along the segments l_s of length ρ, parallel to the x axis, by stiffeners of constant cross section F_0 with the Young's modulus E_0 $(L\cap l_s=\varnothing)$. The case of uniform tension along the x axis at infinity $x\left(\sigma_x^\infty=1,\ \sigma_y^\infty=\tau_{xy}^\infty=0\right)$ is considered. It is assumed that the principle direction of anisotropy E_1 makes an angle φ with the x axis.

Graphs of the intensity coefficients are represented in Fig. 2 for rupture and shear, respectively:

$$k_1=\lim_{t\to c}\sigma_n\sqrt{\frac{r}{l}},\ k_2=\lim_{t\to c}\tau_n\sqrt{\frac{r}{l}},\ r=|t-c|$$

(descending and ascending curves) at the upper end of the crack as a function of the angle ∂ for different ratios between the ellipse semiaxes $R = R_1/R_2$. Here l is half the crack length; c, apex of the crack; and t, a point on the continuation of the crack beyond the end c. The horizontal line corresponds to the value of k_1 at the ends of rectilinear cracks (R = 0). There are no ribs.

Results of computations illustrating the influence of the geometric and stiffness parameters of the structure on the magnitude of the correction factor $k_1^* = k_1/k_{1,\infty}$ ($k_{1,\infty}$ is the intensity factor for a plate without ribs weakened by one rectilinear crack) are shown in Figs. 3-5.

Figure 3 illustrates the dependence of k_1^* on the rib length ρ for the case of symmetrically reinforced ribs. Here φ = 0; U = 0; 1; 10 (the lines 1-3, respectively, $U = E_1\rho h(E_0F_0)^{-1}$ is the relative stiffness of the rib), and the solid lines correspond to the case a = 0.1 while the dashes are for a = 0.2.

Graphs of k_1^* at the lower end of the crack are presented in Fig. 4 as a function of a for the case ρ = 2, U = 0, 1, 10 (lines 1-3, respectively). The solid lines correspond to the case $\varphi=0$, and the dashes to $\varphi=\pi/2$.

The dependence of k_1^* on the rib length ρ at the crack end close to the rib is shown in Fig. 5 for the case s = 0.1, 0.5, ∞ (curves 1-3, respectively), where $\varphi=0$, a = 1.

Results of computations exhibited good convergence of the algorithm. Presented for comparison in the table are values of k_1 in a plate weakened by a rectilinear crack and reinforced by symmetrically arranged stiffeners (see Fig. 3), for $\varphi=0,\ \rho=2$ when N = 10, 20 in system (3.1) and (3.2). As a diminishes and U increases the accuracy lowers somewhat.

Results of the computations for a plate with a rectilinear crack in the case of a passage to the limit to an isotropic material agree well with the data in [7, 11].

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