[illegible]

usually composed of slender but elastic fibres it is of interest to examine the overall effect fibre

[illegible]

continuity may have on results, such as the intensity factor at the bridged flaw.

This paper attempts to provide a simplified theoretical model for the process of flaw bridging in a unidirectional fibre reinforced composite. It is assumed that a penny shaped flaw

[illegible]

where $A_i(\zeta)$ are unknown functions and $\lambda_i = \zeta/a\sqrt{v_i}$. From (5) and (12) we note that in order to satisfy the boundary condition (8) we require

$$\sqrt{v_2}\, A_1(\xi)(1 + k_1) = -\sqrt{v_1}\, A_2(\xi)(1 + k_2) \tag{13}$$

Making use of this result and Eqns. (3), (4) and (12) it can be shown that the boundary conditions (9) and (10) are equivalent to the system of dual integral equations:

$$\int_0^\infty \xi B(\xi) F(\xi) J_0(\xi r/a)\, \mathrm{d}\xi = \frac{p(r)}{2\mu^*}; \quad 0 \leqslant r \leqslant a \tag{14}$$

$$\int_0^\infty B(\xi) J_0(\xi r/a)\, \mathrm{d}\xi = 0; \quad a < r < \infty \tag{15}$$

where

$$B(\xi) = \xi^2 A_2(\xi); \quad F(\xi) = 1 - \frac{\psi}{\xi}$$

5. The stress intensity factor

A result of primary interest to linear elastic fracture mechanics of the fibre reinforced composite concerns the distribution of stress in the vicinity of the boundary of the bridged flaw region. This state of stress is characterized by the stress intensity factor K_{I} (for the flaw opening mode) defined by

$$K_{\mathrm{I}} = \lim_{r \to a^{+}} [2(r-a)]^{\frac{1}{2}} \sigma_{zz}(r,0) \tag{20}$$

By employing the results derived in the previous section it can be shown that

$$[K_{\mathrm{I}}]_{\mathrm{bridged\,flaw}} = \frac{P}{\pi^2 a^{3/2}} \{2\Phi^*(1)\} \tag{21}$$

In the limiting case when the elasticity of the bridging fibres E_f reduces to zero, $\psi = 0$, and (18) gives the result

$$[K_{\mathrm{I}}]_{\mathrm{unbridged\,flaw}} = \frac{P}{\pi^2 a^{3/2}} \frac{(c_{13}+c_{44})\nu_1\nu_2}{c_{33}c_{44}(\nu_1-\nu_2)} \times$$

$$\times \Big[(k_1 c_{33} - \nu_1 c_{13}) - (k_2 c_{33} - \nu_2 c_{13}) \Big] \quad (22)$$

[redacted]

In the limit material isotropy $\nu_1, \nu_2 \to 1$ and

$$c_{11} = c_{33} = \lambda + 2\mu; \quad c_{13} = \lambda; \quad c_{44} = \mu \tag{23}$$

where λ and μ are the classical Lamé constants. Thus for the isotropic case of the body force loading of a penny shaped flaw

$$[K_{\mathrm{I}}]^{\mathrm{isotropic}}_{\mathrm{unbridged\,flaw}} = \frac{P}{\pi^2 a^{3/2}} \left[\frac{(1-\nu) + \eta^2(2-\nu)}{(1-\nu)(1+\eta^2)^2} \right] \tag{24}$$

This is in agreement with the result given by Kassir and Sih [22] and Barenblatt [31]. Also as

[redacted]

$\eta \to 0$, the results (22) and (24) both yield the same result

$$[K_{\mathrm{I}}]^{\mathrm{isotropic}} = [K_{\mathrm{I}}]^{\mathrm{transversely\ isotropic}} = P \quad (25)$$

[redacted]

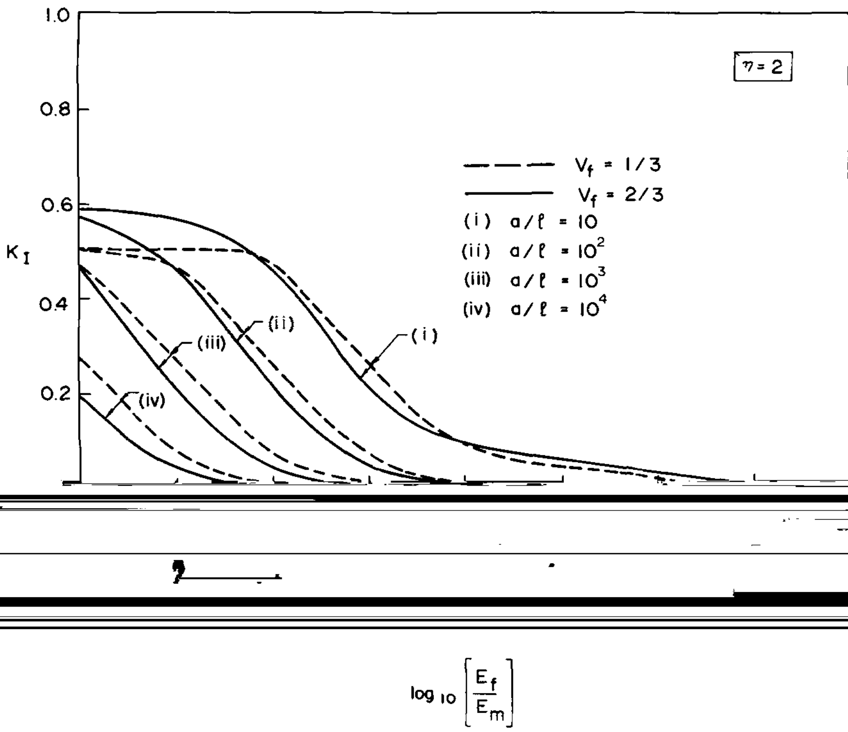

Figure 6. The normalized stress intensity factor $\bar{K}_I$ for the bridged flaw [redacted]

The Figs. 2–6 illustrate the manner in which the various elasticity parameters [redacted]