Fatigue Lifetime Calculation (via Fracture Mechanics)

typically a Paris-type equation is available for a metal (for Region II of da/dN curve):

$$\frac{da}{dN} = A(\Delta K)^m$$

to estimate the fatigue life, rearrange the equation and integrate:

$$dN = \frac{da}{A(\Delta K)^m}$$

$$N_f = \int_0^{N_f} dN = \int_{a_0}^{a_c} \frac{da}{A \Delta K}$$

comments regarding terms on right side of equation:

A_m - are proportionality constants that is known (for example, from laboratory tests)

ΔK - use K equation that is appropriate for the geometry and loading (for example, for center cracked, infinite plate:

$$K = \sigma (\pi a)^{1/2}$$

$$\Delta K = \Delta\sigma (\pi a)^{1/2}$$

- note that ΔK is not constant, containing "a" which must be integrated!

a_c - the crack size at failure (at cycle Nf); calculated using the K equation for the geometry and Pmax in the load cycle

a_o - assumed or known from NDE