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Title: MEASURING RESIDUAL STRESS EFFECTS IN CT SPECIMENS

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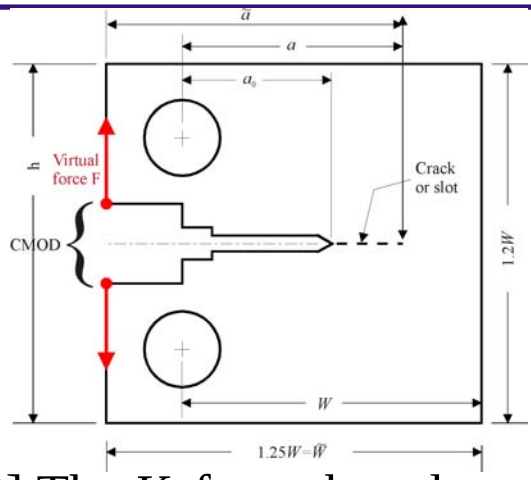


• Following the derivation in [1,2] The K_I from the release of *all* residual stresses up to a is given by:

$$K_{Irs}(a) = \frac{E'}{2B\dfrac{K_{IF}(a)}{F}}\frac{\mathrm{d}(CMOD)}{\mathrm{d}\,a}$$

• A K_{IF} solution of sufficient accuracy is given in [3] as:

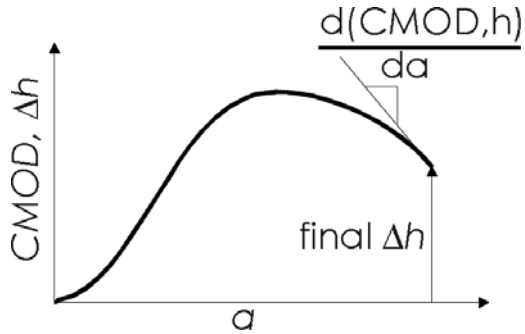
$$\frac{BK_{IF}(a)}{F} = \frac{2.5934 - 3.625\tilde{a} + 32.5162\tilde{a}^2 - 76.1035\tilde{a}^3 + 117.416\tilde{a}^4 - 108.706\tilde{a}^5 + 54.3705\tilde{a}^6 - 11.4149\tilde{a}^7}{(1-\tilde{a})^{3/2}\sqrt{\pi\tilde{a}\tilde{W}}}$$

$$\tilde{a} = \frac{a + 0.25W}{1.25W}, \tilde{W} = 1.25W$$

2/2005: "B" added to make equation correct

• Measurement of height h works also: $\dfrac{\mathrm{d}\,h}{\mathrm{d}\,a} \approx \dfrac{\mathrm{d}(CMOD)}{\mathrm{d}\,a}$

• However using change in h before and after making slot can potentially even give the wrong sign for K_{Irs}



$$-\frac{\mathrm{d}(CMOD)}{\mathrm{d}\,a} \Rightarrow -K_{Irs}$$ correct

$$+\Delta h \not\Rightarrow +K_{Irs}$$ wrong

Because of the equilibrium condition, this curve will always inflect at some point and give a change in the sign of the slope

1. M. B. Prime, "Measuring Residual Stress and the Resulting Stress Intensity Factor in Compact Tension Specimens," *Fatigue & Fracture of Engineering Materials & Structures*, **22**, 195-204, 1999.
2. H.-J. Schindler, W. Cheng, and I. Finnie, "Experimental Determination of Stress Intensity Factors Due to Residual Stresses," *Exp. Mech.* **37**, 272–277, 1997.
3. X. R. Wu and A. J. Carlsson, *Weight Functions and Stress Intensity Factor Solutions*, Pergamon Press, 1991.