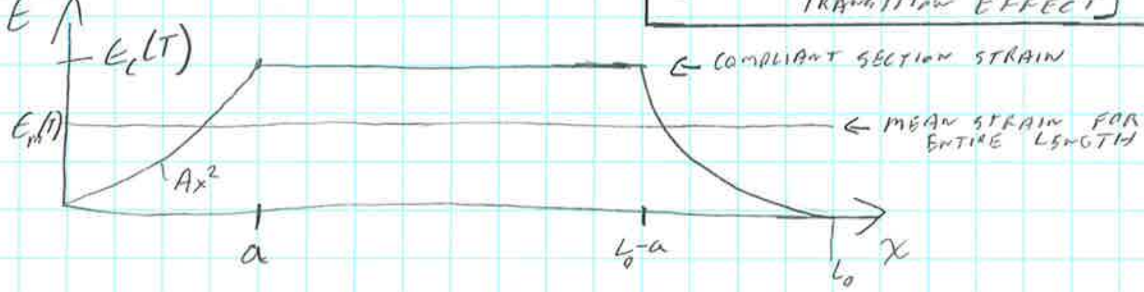
OVERALL STRAIN AS A FUNCTION OF TRANSITION LENGTH AND OVERALL LENGTH [QUADRATIC TRANSITION EFFECT]

4/15/15 - JAH



$$Ax^2\Big|_{x=a} = \epsilon_c \Rightarrow A = \frac{\epsilon_c}{a^2}$$

$$B(L_0 - x)^2\Big|_{x=L_0-a} = \epsilon_c$$

$$B = \frac{\epsilon_c}{a^2}$$

$$\epsilon(x,T) \begin{cases} \frac{\epsilon_c(T)}{a^2}x^2 & 0 \le x < a \\ \epsilon_c(T) & a \le x < L_0 - a \\ \frac{\epsilon_c}{a^2}\left[L_0 - x\right]^2 & L_0 - a \le x \le L_0 \end{cases}$$

$$\epsilon_m(T) = \frac{1}{L_0}\int_0^{L_0} \epsilon(x,T)\,dx$$

$$= \frac{1}{L_0/2}\int_0^{L_0/2} \epsilon(x,t)\,dx$$

} BECAUSE STRAIN PROFILE IS SYMMETRIC ABOUT $L_0/2$

$$= \frac{2\,\epsilon_c(T)}{L_0}\left[\frac{1}{a^2}\int_0^a x^2\,dx + \int_a^{L_0/2} dx\right] = \frac{2\,\epsilon_c(T)}{L_0}\left[\frac{1}{a^2}\left[\frac{x^3}{3}\right]_0^a + \left[x\right]_a^{L_0/2}\right]$$

$$= \frac{2\,\epsilon_c(T)}{L_0}\left[\frac{a}{3} + \frac{L_0}{2} - a\right] = \frac{2\,\epsilon_c(T)}{L_0}\left[\frac{L_0}{2} - \frac{2}{3}a\right]$$

$$\boxed{\epsilon_m(t) = \epsilon_c(t)\left[1 - \frac{4a}{3L_0}\right]}$$

a = TRANSITION LENGTH

L_0 = OVERALL UNSTRETCHED LENGTH

EXAMPLE: FOR 2011 TMT TESTS, $a = 1.9\,m$

$L_0 = 4.5\,m$

$$\epsilon_m(t) = \epsilon_c(T)\left[1 - \frac{4(1.9)}{3(4.5)}\right]$$

$$\epsilon_m(t) = .437\,\epsilon_c(T)$$