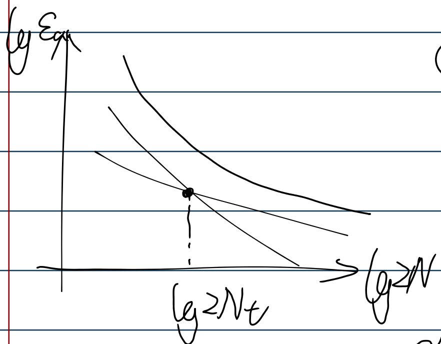
转换寿命的推导

Monday, November 20, 2023 8:41 AM



① ∵对于弹性应变，由Basquin公式,有: $\sigma^m N = C$.

有: $\varepsilon = \frac{\sigma}{E}$, 因而 $\frac{\sigma_f'}{E}(2N)^b = \varepsilon_{ea}$.

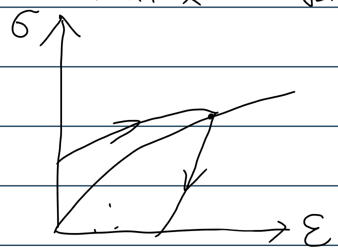
$\varepsilon_f'(2N)^c = \varepsilon_{pa}$.

此时: 令: $\varepsilon_{ea} = \varepsilon_{pa}$, 则有:

$\frac{\sigma_f'}{E}(2N)^b = \varepsilon_f'(2N)^c$. 从而有:

$\therefore (2N)^{b-c} = \frac{E\varepsilon_f'}{\sigma_f'} \Rightarrow 2N_t = \left(\frac{E\varepsilon_f'}{\sigma_f'}\right)^{\frac{1}{b-c}}$.

∵需要说明的是在疲劳曲线上，由于滞回环稳态时,应变表达为:



由Ramberg-Osgood关系 $\varepsilon = \varepsilon_{ea} + \varepsilon_{pa} = \frac{\sigma_a}{E} + \left[\frac{\sigma_a}{K'}\right]^{\frac{1}{n'}}$

有 $\varepsilon = \varepsilon_{ea} + \varepsilon_{pa} = \frac{\sigma_f'}{E}\cdot(2N)^b + \varepsilon_f'(2N)^c$,

而显然有 $\varepsilon_{ea} = \frac{\sigma_a}{E} = \frac{\sigma_f'}{E}(2N)^b \Rightarrow \sigma_a = \sigma_f'(2N)^b$,

又: $\varepsilon_{pa} = \varepsilon_f'(2N)^c = \left(\frac{\sigma_a}{K'}\right)^{\frac{1}{n'}}$ 时,

从而有: $\varepsilon_{pa} = \left(\frac{\sigma_a}{K'}\right)^{\frac{1}{n'}} = \left(\frac{\sigma_f'}{K'}(2N)^b\right)^{\frac{1}{n'}} = \varepsilon_f' \cdot (2N)^c$, 从而有公式:

$\left(\frac{\sigma_f'}{K'}\right)^{\frac{1}{n'}} = \varepsilon_f'$, $(2N)^{\frac{b}{n'}} = (2N)^c$, 即得:

$K' = \frac{\sigma_f'}{\varepsilon_f'^{n'}}$, 得关系 $\begin{cases} n' = \frac{b}{c}, \\ K' = \frac{\sigma_f'}{(\varepsilon_f')^{\frac{b}{c}}} \end{cases}$

其中: $b \approx -0.1$

$c \approx -0.5 \sim -0.7$.