

疲劳极限估计公式推导

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我们假设材料的疲劳极限和极限强度分别为 σ_f, σ_u ,

首先: 假定 $N = 10^3$ 对应的疲劳强度为 $0.9 \sigma_u$, 而假定极限寿命为 10^6 周次

即: 由 Basquin 公式

$$\sigma_u^m N = C$$

$$\text{即: } (0.9 \sigma_u)^m \cdot 10^3 = C$$

$$(\sigma_f)^m \cdot 10^6 = C$$

$$\therefore (0.9 \sigma_u)^m \cdot 10^3 = \sigma_f^m \cdot 10^6, \text{ 两边同取对数}$$

$$m(0.9 + \lg \sigma_u) = m(\lg \sigma_f + 3),$$

$$\therefore m = \frac{3}{\lg 0.9 + \lg \frac{\sigma_u}{\sigma_f}} = \boxed{\frac{3}{\lg 0.9 - \lg K}}, \text{ 其中 } K = \frac{\sigma_f}{\sigma_u}$$

$\lg C = 3 + m \times (\lg 0.9 + \lg \sigma_u)$, 故有:

$$C = \lg^{-1} \left[3 + \frac{3(\lg 0.9 + \lg \sigma_u)}{\lg 0.9 - \lg K} \right] = \lg^{-1} \left[\frac{6(\lg 0.9 + 3(\lg K - \lg \sigma_u))}{\lg 0.9 - \lg K} \right] \checkmark$$