Equations

Problem 8.26

A cylindrical 1045 steel bar is subjected to repeated compression-tension stress cycling along its axis. If the load amplitude is ...

\[ F_{\text{amplitude}} = 66700 \text{ [N]} \quad (1) \]

Compute the minimum allowable bar diameter to ensure that there is no fatigue failure. Use \( FS = 2.0 \)

\[ FS = 2.0 \quad (2) \]

Solution

From Figure 8.44 the endurance limit of the material is about ..

\[ \sigma_{\text{endurance}} = 320 \text{ [MPa]} \quad (3) \]

Use the factor of safety, and get the working stress amplitude

\[ \sigma_{\text{amplitude}} = \sigma_{\text{endurance}} / FS \quad (4) \]

And then calculate the area and diameter

\[ \sigma_{\text{amplitude}} = F_{\text{amplitude}} / A \quad (5) \]

\[ A = \pi/4 \cdot d^2 \quad (6) \]

Solution

\[
\begin{align*}
A &= 416.9 \text{ [mm}^2]\quad d = 23.04 \text{ [mm]} \\
FS &= 2 \quad F_{\text{amplitude}} = 66700 \text{ [N]} \\
\sigma_{\text{amplitude}} &= 160 \text{ [MPa]} \quad \sigma_{\text{endurance}} = 320 \text{ [MPa]}
\end{align*}
\]