

For  
Torsional  
SHCAR.

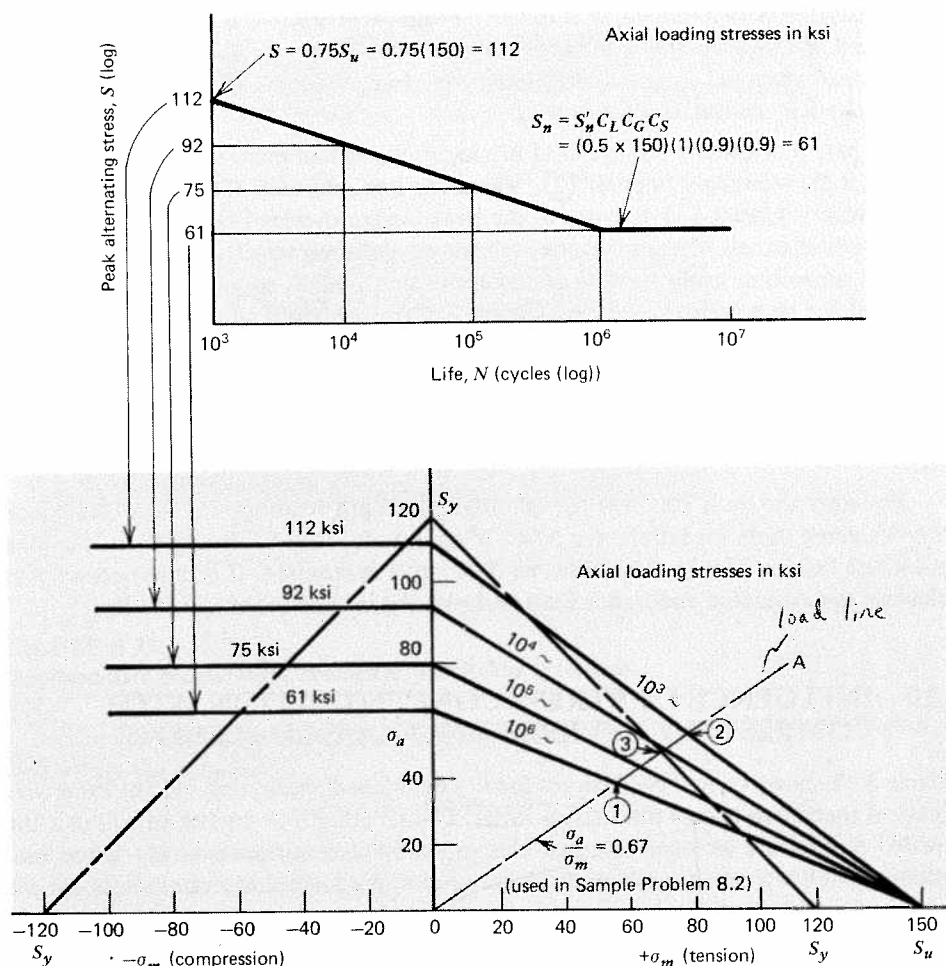
$$\begin{cases} S_{us} = .8 S_u \\ S_{ys} = .58 S_y \end{cases}$$


FIGURE 8.21.

Sample Problem 8.1—Estimate  $S$ - $N$  and  $\sigma_m - \sigma_a$  curves for steel,  $S_u = 150$  ksi, axial loading, commercially polished surfaces.

### Solution

1. The fatigue strength properties of the material conform to those represented in Fig. 8.21 *provided* the diameter comes out to be under 2 in.
2. At the *design overload*:  $\sigma_m = 6000/A$ ,  $\sigma_a = 4000/A$ . Thus, regardless of the area,  $\sigma_a / \sigma_m = 0.67$ . This is represented by line  $OA$  on Fig. 8.21. Note the interpretation of this line: If area  $A$  is infinite, both  $\sigma_m$  and  $\sigma_a$  are zero, and the stresses are represented by the origin, point  $O$ . Moving out along line  $OA$  corresponds to progressively decreasing values of  $A$ . For part *a* of the problem we need to determine the area corresponding to the intersection of  $OA$  with the infinite life line (same as  $10^6$  cycles, in this case), which is labeled ①. At this point,  $\sigma_m = 57$  ksi; from  $\sigma_m =$