

216 FUNDAMENTALS

σ_m = mean stress (constant static stress)
 σ_a = alternating stress
 as σ_m increases, σ_a decreases to stay inside S_u value

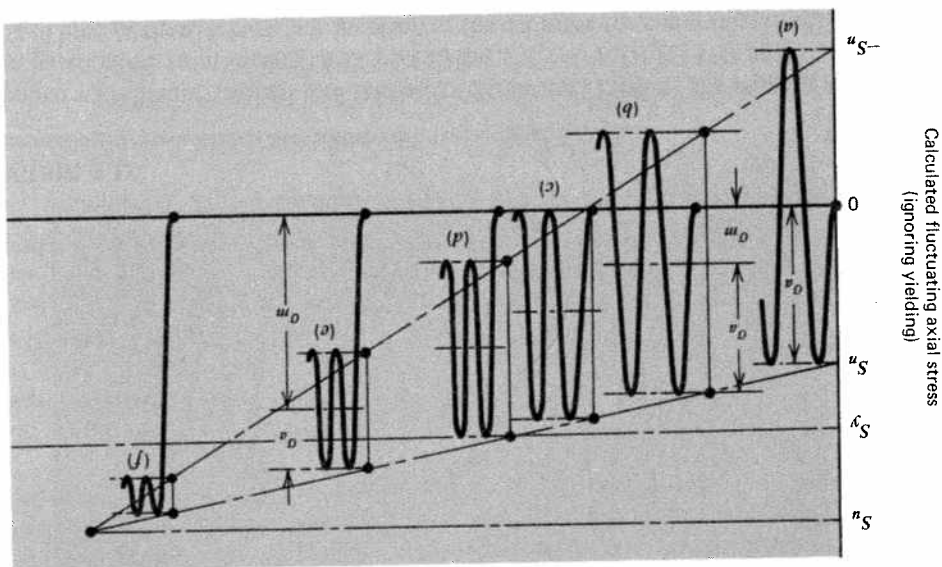


FIGURE 8.16. Various fluctuating uniaxial stresses, all of which correspond to equal fatigue life.

P/A values. Microscopic yielding occurs even at (a), as has been previously noted. Upon reaching (d), macroscopic yielding begins. Although load fluctuations (e) and (f) give "infinite" life, the part is yielded on the first load application. Figure 8.17 gives a convenient graphical representation of various combinations of mean and alternating stress in relation to criteria both for yielding and for various fatigue lives. It is often called a *constant life fatigue diagram* because it has lines corresponding to a constant 10^6 cycle (or "infinite") life, constant 10^5 cycle life, and so forth. To begin the construction of this diagram, put on it first the information that is already known. The horizontal axis ($\sigma_m = 0$) corresponds to static loading. Yield and ultimate strengths are plotted at points A and B . For ductile materials, the compressive yield strength is minus S_y , and this is plotted at point A' . If the mean stress is zero and the alternating stress is equal to S_y (point A''), the stress fluctuates between $+S_y$ and $-S_y$. All points along the line AA'' correspond to fluctuations having a tensile peak of $-S_y$; all points on $A'A''$ correspond to compressive peaks equal to $-S_y$. All combinations of σ_m and σ_a causing no (macroscopic) yielding are contained within triangle $AA'A''$. All $S-N$ curves considered in this chapter correspond to $\sigma_m = 0$. Hence, we can read from these curves points like C , D , E , and F for any fatigue life of interest. Connecting these points with B gives estimated lines of constant life. This empirical procedure for obtaining constant life lines is credited to Goodman; hence the lines are commonly called *Goodman lines*. Laboratory tests have consistently indicated that compressive mean stresses do not reduce the amplitude of allowable alternating stress; if anything, they slightly increase it. Figure 8.17 is thus conservative in showing the constant life lines as horizontal to the