of the applied load and the bolt feels little additional load above that of the initial preload. This is one aspect of the justification for the earlier statement that "if the bolt doesn't fail when preloaded, it probably won't fail in service." There is also another reason for this being true, which will be discussed in a later section.

Note, however, that if the applied load P is large enough to cause the component P_m to exceed the preload force F_i, then the joint will separate, F_m will be zero, and the bolt will feel the full value of the applied load P. The material can no longer contribute to supporting the load if the joint is separated. This is one reason for the very large recommended preloads as a percentage of bolt proof strength. In order to get the full benefit of material load sharing, the preload should be high.

We can summarize the information in Figure 15-24 in the following way. The common change in deflection $\Delta\delta$ due to the applied load P is

$$\Delta\delta = \frac{P_b}{k_b} = \frac{P_m}{k_m} \tag{15.13a}$$

or:

$$P_b = \frac{k_b}{k_m} P_m \tag{15.13b}$$

Substitute equation 15.12*a* to get

$$P_b = \frac{k_b}{k_m + k_b} P$$

or

$$P_b = CP \qquad \text{where} \quad C = \frac{k_b}{k_m + k_b} \tag{15.13c}$$

The term C is called the joint's *stiffness constant* or just the **joint constant**. Note that C is typically < 1, and if k_b is small compared to k_m, C will be a small fraction. This confirms that the bolt will see only a portion of the applied load P.

In like fashion,

$$P_m = \frac{k_m}{k_b + k_m} P = (1 - C) P \tag{15.13d}$$

These expressions for P_b and P_m can be substituted into equations 15.12*b* and 15.12*c* to get expressions for the bolt and material loads in terms of the applied load P:

$$F_m = F_i - (1 - C) P \tag{15.14a}$$

$$F_b = F_i + CP \tag{15.14b}$$

Equation 15.14*b* can be solved for the preload F_i needed for any given combination of applied load P and maximum allowable bolt (proof) load F_b, provided that the joint constant C is known.

The load P_0 required to separate the joint can be found from equation 15.14*a* by setting F_m to zero.

$$P_0 = \frac{F_i}{(1 - C)} \tag{15.14c}$$