

## CODE

calculated in accordance with 6.8, or where moments in two-way slabs are determined using pattern loading specified in 6.4.3.3, reduction of moments at sections of maximum negative or maximum positive moment calculated by elastic theory shall be permitted for any assumed loading arrangement if (a) and (b) are satisfied:

- (a) Flexural members are continuous
- (b)  $\epsilon_t \geq 0.0075$  at the section at which moment is reduced

**6.6.5.2** For prestressed members, moments include those due to factored loads and those due to reactions induced by prestressing.

**6.6.5.3** At the section where the moment is reduced, redistribution shall not exceed the lesser of  $1000\epsilon_t$  percent and 20 percent.

**6.6.5.4** The reduced moment shall be used to calculate redistributed moments at all other sections within the spans such that static equilibrium is maintained after redistribution of moments for each loading arrangement.

**6.6.5.5** Shears and support reactions shall be calculated in accordance with static equilibrium considering the redistributed moments for each loading arrangement.

## COMMENTARY

develop at sections of maximum positive or negative moment and cause a shift in the elastic moment diagram. The usual result is a reduction in the values of maximum negative moments in the support regions and an increase in the values of positive moments between supports from those calculated by elastic analysis. However, because negative moments are typically determined for one loading arrangement and positive moments for another (6.4.3 provides an exception for certain loading conditions), economies in reinforcement can sometimes be realized by reducing maximum elastic positive moments and increasing negative moments, thus narrowing the envelope of maximum negative and positive moments at any section in the span (Bondy 2003). Plastic hinges permit utilization of the full capacity of more cross sections of a flexural member at ultimate loads.

The Code permissible redistribution is shown in Fig. R6.6.5. Using conservative values of limiting concrete strains and lengths of plastic hinges derived from extensive tests, flexural members with small rotation capacities were analyzed for redistribution of moments up to 20 percent, depending on the reinforcement ratio. As shown, the permissible redistribution percentages are conservative relative to the calculated percentages available for both  $f_y = 60 \text{ ksi}$  and  $80 \text{ ksi}$ . Studies by Cohn (1965) and Mattock (1959) support this conclusion and indicate that cracking and deflection of beams designed for redistribution of moments are not significantly greater at service loads than for beams designed by the distribution of moments according to elastic theory. Also, these studies indicate that adequate rotational capacity for the redistribution of moments allowed by the Code is available if the members satisfy 6.6.5.1.

The provisions for redistribution of moments apply equally to prestressed members (Mast 1992).

The elastic deformations caused by a nonconcordant tendon change the amount of inelastic rotation required to obtain a given amount of redistribution of moments. Conversely, for a beam with a given inelastic rotational capacity, the amount by which the moment at the support may be varied is changed by an amount equal to the secondary moment at the support due to prestressing. Thus, the Code requires that secondary moments caused by reactions generated by prestressing forces be included in determining design moments.

Redistribution of moments as permitted by 6.6.5 is not appropriate where approximate values of bending moments are used, such as provided by the simplified method of 6.5.

Redistribution of moments is also not appropriate for two-way slab systems that are analyzed using the pattern loadings given in 6.4.3.3. These loadings use only 75 percent of the full factored live load, which is based on considerations of moment redistribution.