CODE

6.2.5.3 Unless slenderness effects are neglected as permitted by 6.2.5.1, the design of columns, restraining beams, and other supporting members shall be based on the factored forces and moments considering second-order effects in accordance with 6.6.4, 6.7, or 6.8. M_u including second-order effects shall not exceed $1.4M_u$ due to first-order effects.

COMMENTARY

R6.2.5.3 Design considering second-order effects may be based on the moment magnifier approach (MacGregor et al. 1970; MacGregor 1993; Ford et al. 1981), an elastic second-order analysis, or a nonlinear second-order analysis. Figure R6.2.5.3 is intended to assist designers with application of the slenderness provisions of the Code.

End moments in compression members, such as columns, walls, or braces, should be considered in the design of adjacent flexural members. In nonsway frames, the effects of magnifying the end moments need not be considered in the design of adjacent beams. In sway frames, the magnified end moments should be considered in designing the adjoining flexural members.

Several methods have been developed to evaluate slenderness effects in compression members subject to biaxial bending. A review of some of these methods is presented in Furlong et al. (2004).

If the weight of a structure is high in proportion to its lateral stiffness, excessive $P\Delta$ effects, where secondary moments are more than 25 percent of the primary moments, may result. The $P\Delta$ effects will eventually introduce singularities into the solution to the equations of equilibrium, indicating physical structural instability (Wilson 1997). Analytical research (MacGregor and Hage 1977) on reinforced concrete frames showed that the probability of stability failure increases rapidly when the stability index Q, defined in 6.6.4.4.1, exceeds 0.2, which is equivalent to a secondary-to-primary moment ratio of 1.25. According to ASCE/SEI 7, the maximum value of the stability coefficient θ, which is close to the ACI stability coefficient Q, is 0.25. The value 0.25 is equivalent to a secondary-to-primary moment ratio of 1.33. Hence, the upper limit of 1.4 on the secondary-to-primary moment ratio was chosen.