CODE

(a) The increase in column end moments due to second-order effects does not exceed 5 percent of the first-order end moments

(b) Q in accordance with 6.6.4.4.1 does not exceed 0.05

6.6.4.4 *Stability properties*

6.6.4.4.1 The stability index for a story, Q, shall be calculated by:

$$Q = \frac{\Sigma P_u \Delta_o}{V_{us} \ell_c} \qquad (6.6.4.4.1)$$

where $\sum P_u$ and V_{us} are the total factored vertical load and horizontal story shear, respectively, in the story being evaluated, and Δ_o is the first-order relative lateral deflection between the top and the bottom of that story due to V_{us}.

6.6.4.4.2 The critical buckling load P_c shall be calculated by:

$$P_c = \frac{\pi^2 (EI)_{eff}}{(k\ell_u)^2} \qquad (6.6.4.4.2)$$

6.6.4.4.3 The effective length factor k shall be calculated using E_c in accordance with 19.2.2 and I in accordance with 6.6.3.1.1. For nonsway members, k shall be permitted to be taken as 1.0, and for sway members, k shall be at least 1.0.

6.6.4.4.4 For columns, $(EI)_{eff}$ shall be calculated in accordance with (a), (b), or (c):

(a) $$(EI)_{eff} = \frac{0.4 E_c I_g}{1+\beta_{dns}} \qquad (6.6.4.4.4a)$$

(b) $$(EI)_{eff} = \frac{(0.2 E_c I_g + E_s I_{se})}{1+\beta_{dns}} \qquad (6.6.4.4.4b)$$

(c) $$(EI)_{eff} = \frac{E_c I}{1+\beta_{dns}} \qquad (6.6.4.4.4c)$$

COMMENTARY

classified as nonsway based on the stability index for a story, Q. In calculating Q, $\sum P_u$ should correspond to the lateral loading case for which $\sum P_u$ is greatest. A frame may contain both nonsway and sway stories.

If the lateral load deflections of the frame are calculated using service loads and the service load moments of inertia given in 6.6.3.2.2, it is permissible to calculate Q in Eq. (6.6.4.4.1) using 1.2 times the sum of the service gravity loads, the service load story shear, and 1.4 times the first-order service load story deflections.

R6.6.4.4 *Stability properties*

R6.6.4.4.2 In calculating the critical axial buckling load, the primary concern is the choice of a stiffness $(EI)_{eff}$ that reasonably approximates the variations in stiffness due to cracking, creep, and nonlinearity of the concrete stress-strain curve. Section 6.6.4.4.4 may be used to calculate $(EI)_{eff}$.

R6.6.4.4.3 The effective length factor for a compression member, such as a column, wall, or brace, considering braced behavior, ranges from 0.5 to 1.0. It is recommended that a k value of 1.0 be used. If lower values are used, the calculation of k should be based on analysis of the frame using I values given in 6.6.3.1.1. The Jackson and Moreland Alignment Charts (Fig. R6.2.5.1) can be used to estimate appropriate values of k (ACI SP-17M(09); Column Research Council 1966).

R6.6.4.4.4 The numerators of Eq. (6.6.4.4.4a) to (6.6.4.4.4c) represent the short-term column stiffness. Equation (6.6.4.4.4b) was derived for small eccentricity ratios and high levels of axial load. Equation (6.6.4.4.4a) is a simplified approximation to Eq. (6.6.4.4.4b) and is less accurate (Mirza 1990). For improved accuracy, $(EI)_{eff}$ can be approximated using Eq. (6.6.4.4.4c).

Creep due to sustained loads will increase the lateral deflections of a column and, hence, the moment magnification. Creep effects are approximated in design by reducing the stiffness $(EI)_{eff}$ used to calculate P_c and, hence, δ, by dividing the short-term EI provided by the numerator of Eq. (6.6.4.4.4a) through (6.6.4.4.4c) by $(1 + \beta_{dns})$. For