response estimates are necessary. Most computer codes used in the analysis of structures would provide estimates of the natural frequencies of the structure being analyzed. However, for the preliminary design stages some empirical relationships for building period T_a ($T_a = 1/n_1$) are available in the earthquake chapters of ASCE 7. However, it is noteworthy that these expressions are based on recommendations for earthquake design with inherent bias toward higher estimates of fundamental frequencies (Goel and Chopra 1997 and 1998). For wind design applications these values may be unconservative because an estimated frequency higher than the actual frequency would yield lower values of the gust effect factor and concomitantly a lower design wind pressure. However, Goel and Chopra (1997 and 1998) also cite lower bound estimates of frequency that are more suited for use in wind applications. These lower-bound expressions are now given in Section 26.9.2; graphs of these expressions are shown in Fig. C26.9-1. Because these expressions are based on regular buildings, limitations based on height and slenderness are required. The effective length L_{eff}, uses a height-weighted average of the along-wind length of the building for slenderness evaluation. The top portion of the building is most important; hence the height-weighted average is appropriate. This method is an appropriate first-order equation for addressing buildings with setbacks. Explicit calculation of gust effect factor per the other methods given in Section 26-9 can still be performed.

Observation from wind tunnel testing of buildings where frequency is calculated using analysis software reveals the following expression for frequency, appropriate for buildings less than about 400 ft in height, applicable to all buildings in steel or concrete:

$$n_1 = 100/H \text{ (ft) average value} \quad \text{(C26.9-6)}$$

$$n_1 = 75/H \text{ (ft) lower bound value} \quad \text{(C26.9-7)}$$

Equation C26.9-7 for the lower bound value is provided in Section 26.9.2.

Based on full-scale measurements of buildings under the action of wind, the following expression has

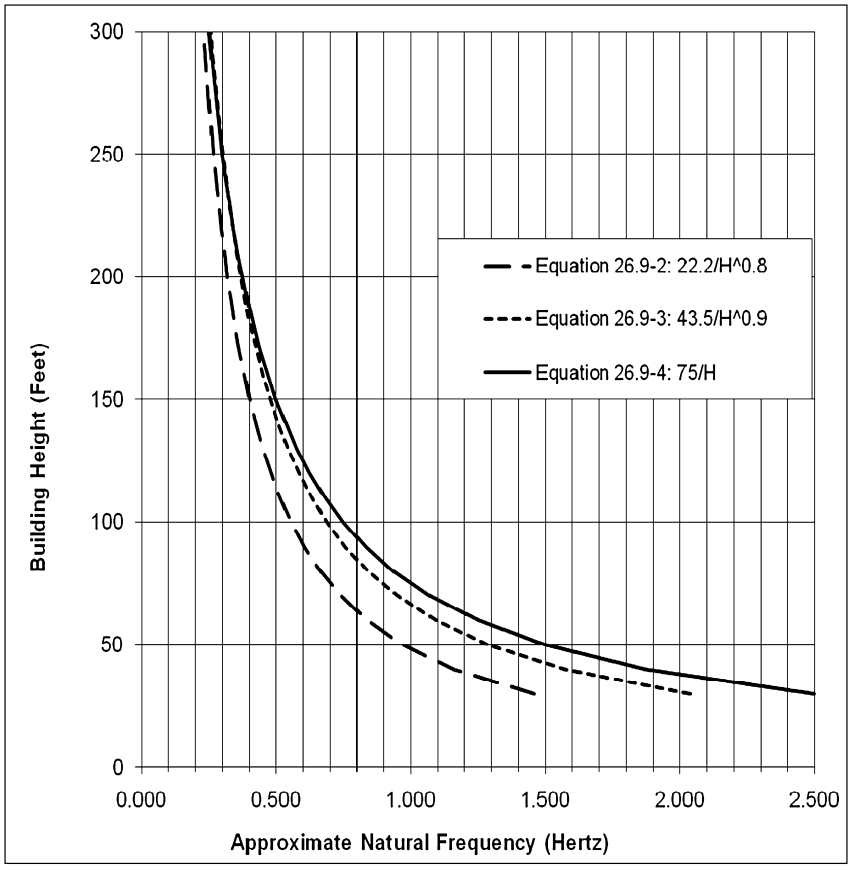

FIGURE C26.9-1 Equations for Approximate Natural Frequency na vs. Building Height.